Municipal Engineering

Design, Construction, Operation and Maintenance of All Public Works

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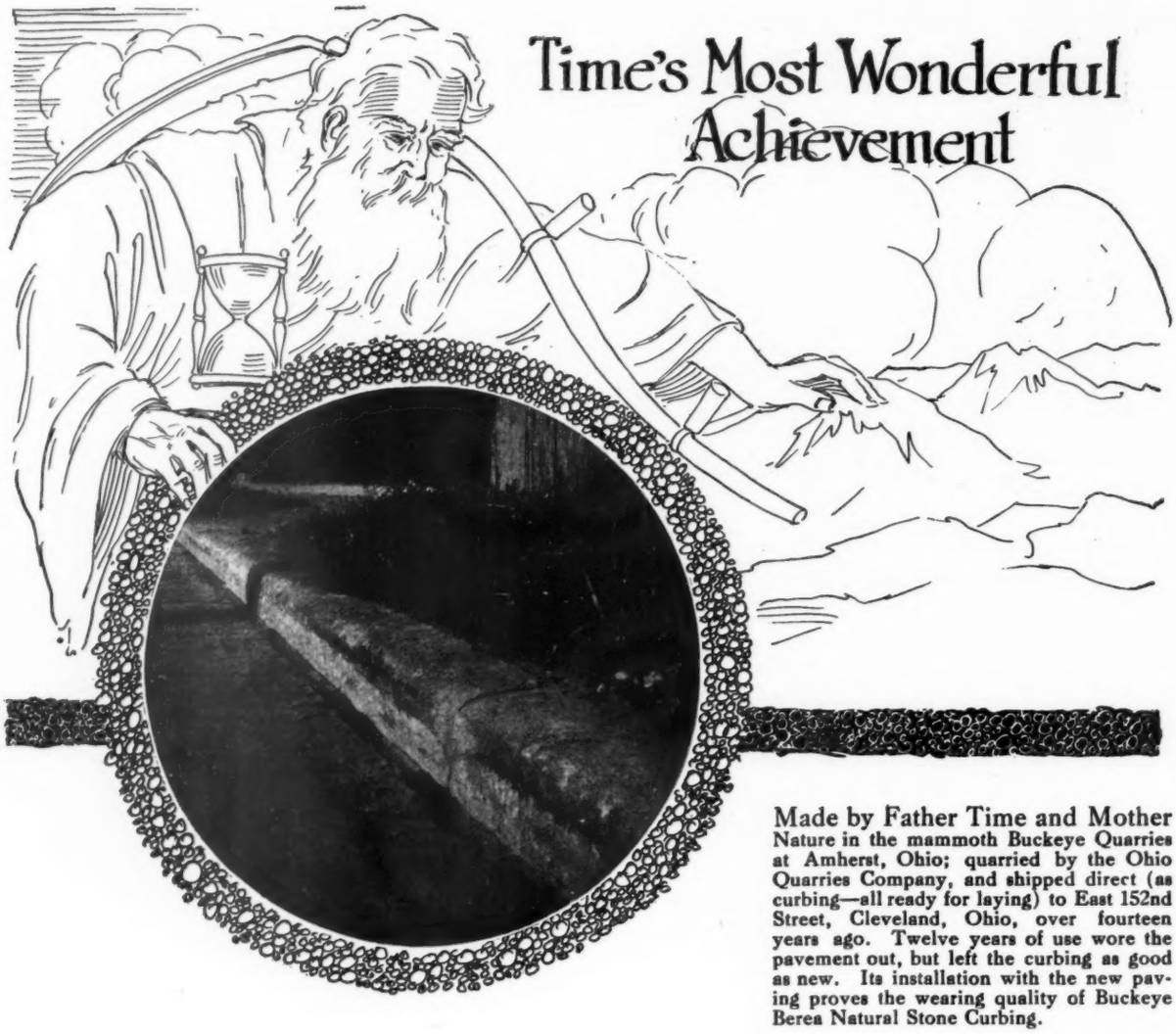

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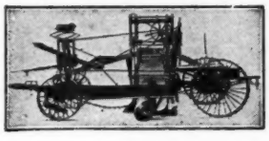

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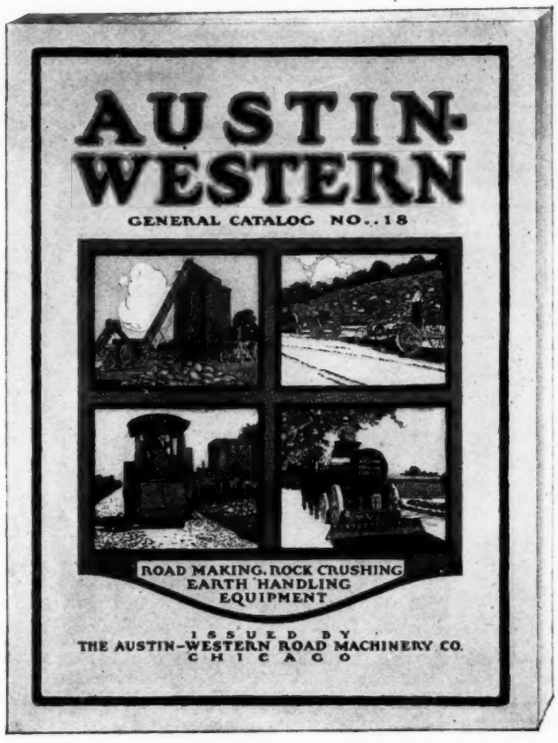

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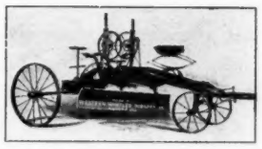

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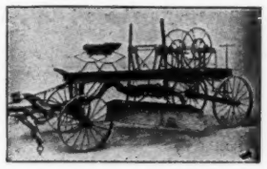

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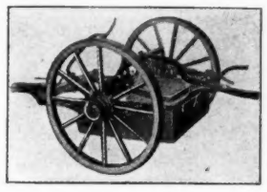

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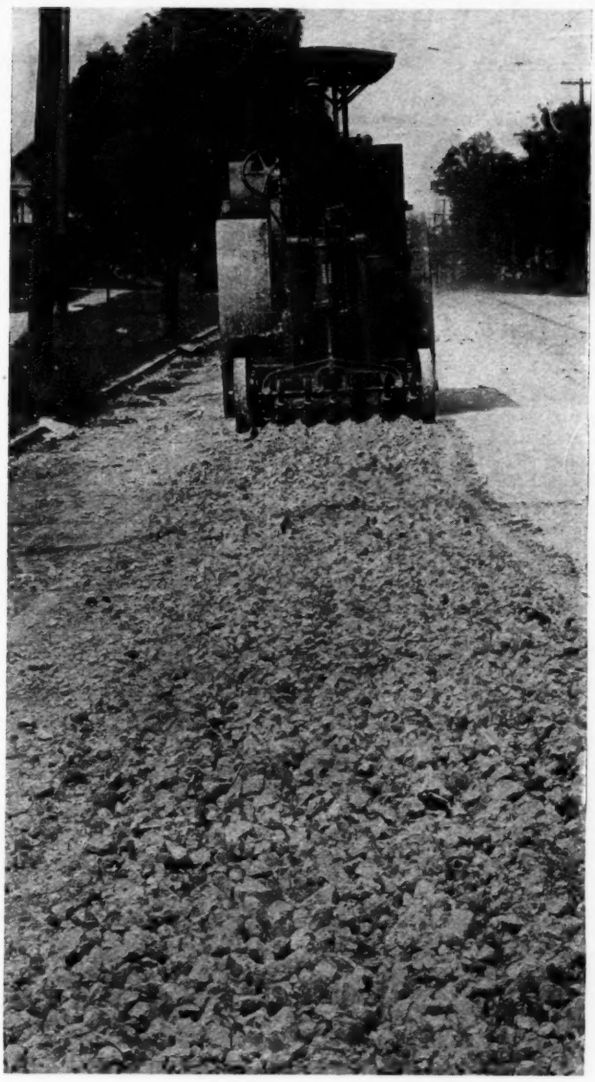
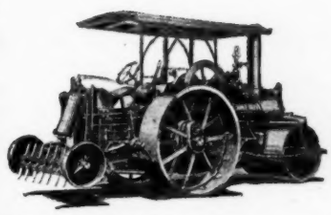
Buffalo-Springfield Pneumatic Scarifier

Accomplishes Three to Five Times Amount of Work Possible with any other method.

Standard 10-Ton Kelly Steam Macadam Roller with Attached Scarifier.





Standard 10-Ton Buffalo-Pitts Macadam Roller with Attached Scarifier.

Enters work instantly upon opening valve lever. Raises automatically upon striking hidden obstacles. Operator can raise scarifier instantly upon passing over crosswalks, manhole covers, etc.

Direct connected Compression Cylinder, giving force sufficient for tearing up hardest stone streets and roads and with long stroke to give elasticity required to maintain uniform cutting depth on extremely uneven surfaces.

"The Buffalo-Springfield Pressure Cylinder Scarifier *is thorough* in its results.

"And its operation is *simple* and convenient," states County Engineer Frederick S. Smith, of Morristown, N. J. "The County has had the roller and scarifier in constant use all season and have heard nothing but words of commendation for it."

Buffalo-Springfield Roller Co.

SOLE MANUFACTURERS OF BUFFALO-PITTS AND KELLY-SPRINGFIELD ROLLERS

SPRINGFIELD OHIO

BUYERS' GUIDE

Sidewalks (Stone).
Cleveland Stone Co.
Ohio Quarries Co., The

Sign Posts.
Cutter Co., Geo.

Sluice Gates.
Coldwell-Wilcox Co.

Sprinklers.
Austin-Western Road Machinery Co., The

Steel Joists, Studs and Sash.
Trussed Concrete Steel Co.

Steel Tapes.
Kolesch & Co.
Lufkin Rule Co., The

Stone Curbing.
Cleveland Stone Co.
Ohio Quarries Co.

Stone Flagging.
Cleveland Stone Co.
Ohio Quarries Co., The

Street Cleaners' Carts.
Holzbog & Bro., Geo. H.

Street Cleaning Machinery (Horse Drawn).
Austin-Western Road Machinery Co., The

Street Crossings.
Cleveland Stone Co.
Ohio Quarries Co., The

Street Flushers (Horse Drawn).
Austin-Western Road Machinery Co.

Street Lighting.
Cutter Co., Geo.

Street Sprinklers (Horse Drawn).
Austin-Western Co., Ltd., The

Structural Steel.
Lewis-Hall Iron Works.

Surveyors' Instruments.
Kolesch & Co.
Lufkin Rule Co., The

Sweepers.
Austin-Western Road Machinery Co., The

Tamping Machines.
Pawling and Harnischfeger.

Tar and Pitch.
The Barrett Co.
DuPont Chemical Co.

Tar Heaters.
Alger Supply Co.
Littleford Bros.

Tarvia.
The Barrett Co.

Testing Chemists.
Dow & Smith.
Howard, J. W.
Kirschbraun, Lester.
Van Trump, Isaac.

Testing Laboratories.
Howard, J. W.
Hunt & Co., R. W.
Lester Kirschbraun.
Tinius Olsen Testing Machine Co.

Traction Engines.
Austin-Western Road Machinery Co., The

Traction Engines (Oil or Kerosene).
Austin-Western Road Mach. Co.

Trailers.
Warner Mfg. Co.

Trench Braces.
Kalamazoo Fdy. & Mach. Co.

Trench Machinery.
Holzbog & Bro., Geo. H.
Kalamazoo Fdy. & Machine Co.
Pawling and Harnischfeger.

Trucks (Motor).
Acme Motor Truck Co.
American Motor Truck Co.
Columbia Motor Truck & Trailer Co.
Couple-Gear Freight-Wheel Co.
Detroit Truck Co.
Diamond T Motor Car Co.
Duplex Truck Co.
Garford Motor Truck Co., The
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Warrenite.
Warren Bros. Co.

Water Pipe.
American Cast Iron Pipe Co.
Warren Foundry & Machine Co.

Waterproofing.
Barrett Co., The
Pioneer Asphalt Co.
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Water Purification.
Pennsylvania Salt Mfg. Co.

Water Works Supplies and Equipment.
American Cast Iron Pipe Co.
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Windows (Steel).
Trussed Concrete Steel Co.

Wire-Cut Lug Brick.
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Medal Paving Brick Co.
Metropolitan Paving Brick Co.
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Southern Clay Mfg. Co.
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Wood Block (Creosoted).
Barrett Co., The
Jennison-Wright Co.
Republic Creosoting Co.

Wood Preservatives.
Barrett Co., The
DuPont Chemical Co.
Jennison-Wright Co.
Pioneer Asphalt Co.
Republic Creosoting Co.

Federal Highway Board—Needed!

Resolution adopted by Chamber of Commerce of the United States in convention at Atlantic City, September 21, 1917.

WHEREAS, It is essential that all the transportation facilities of the Nation should be brought to the highest state of efficiency in order that foodstuffs may be moved most economically from the farm to the market, that manufactured products be moved at the lowest cost from the factory to the consumer; and

WHEREAS, The Public Highways offer a good, prompt and economical means to supplement transportation by rail and water; therefore,

BE IT RESOLVED, That the prompt improvement of our Public Highways is important and should be forwarded in every proper way.

Realizing the transportation congestion crisis, this was one of the most important resolutions passed by the Chamber of Commerce of the United States. Motor Trucks are ready at hand; **the roads of the Nation must be immediately developed and improved. A Federal Highway Board is urgently needed.**

The Best Oil—By Far!

THE creosote oil that made possible your modern wood block pavements was first produced by this company. And today more than one-third of all the wood block pavements in this country are preserved with Reilly oils.

Now we offer a new product—Reilly's Improved Creosote Oil—by far the best oil ever produced. Made by a new and patented method. An oil so superior to other products that it contains more than three times the permanent constituents of the next best oil.

Without an equal for treating wood blocks, railroad ties, telephone cross arms, under-ground and under-water timbers—any wood that is to be preserved by the empty cell process.

Contains no trace of coal tar or other impurities. In your distilling test you will find that more than 75% remains at 315 degrees Centigrade.

It stays in the wood forever.

Prompt Shipments!

Under present conditions our large stock and prompt shipping facilities are exceedingly important. We can fill your orders promptly at any of our refineries. Samples gladly submitted.

Reilly's Wood Preservative Oil

is our best product for open tank or brush treatment. A high-boiling anthracene oil—limpid and free-flowing at working temperatures. Contains no adulterant or volatile products.

Send for Sample

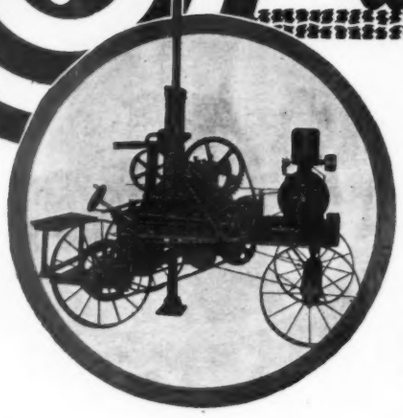
Treated Timbers!

If you are not in position to treat your own ties and dimension timbers we will be glad to submit attractive prices. Tell us your requirements in this line. We will take care of you.

Republic Creosoting Company

Plants: Indianapolis—Minneapolis—Seattle—Mobile **Indianapolis, Indiana**

A "Bull's Eye" every shot with a P&H



"ONE 'P & H' Power Traction Tamper does the work of sixteen hand tampers and two shovelers. It strikes 42 (150-lb.) sledge-hammer blows per minute, and it is operated by *one* man.

"Human muscle (no matter how willing or plentiful) *can't* compete with 'P & H' power. It takes power and lots of it to ram all the dirt (you take out) back into the trench."

"P & H" Power Traction Tampers not only do more work but *better* work—and *speedier—costs less.*

Lest You Forget—

1. "It's a one-man machine." (Labor is scarce.)
2. "Does the work of 16 hand tampers and two shovelers." (Labor costs money.)
3. "42 (150-lb.) blows per minuie." (Speeds up the work.)
4. "When it's 'P & H' Tamped it's tamped to stay." (No trench settling.)

Get details about the "P & H" Power Traction Tamper. You ought to be acquainted with this "slam-banger."

Pawling & Harnischfeger Co.
MILWAUKEE, WIS.

Lower the Cost of Grading— Speed Up the Spading!

A Pennsylvanian contractor was "up against" a time contract, labor shortage and very hard excavating. By using low-strength dynamite to

Blast Ahead of Shovels

they handled the gravel and shale easily and quickly and the contract was completed on time.

With a few cartridges of Red Cross Extra Dynamite exploded ahead of the shoveling gangs, it takes less time and labor and yardage per day increases. Blasting takes the strain off the steam shovel, helps it to dig faster, cheaper and easier.

Ask for free booklet, *"Road Construction and Maintenance."* Learn how to use Red Cross Explosives to lower the cost of grading and speed-up spading. Mention "Municipal Engineering" and address Advertising Division

LOWERING COST OF HARD-ROAD GRADING.

A contractor on a Pennsylvania road has completed his work at a lower cost than was attained on other sections of the road by using machinery to an unusual extent. On account of the high price of labor and its scarcity, he used a steam shovel in all cuts, low-strength dynamite to loosen the material and speed up the work of the shovel, and automatic dump wagons to remove the earth and shale as it was excavated. The outfall drainage ditches were blasted out with dynamite, thereby reducing the cost of excavation and of trimming the slopes.

The work was finished on time, in addition to being done at a relatively low figure for the conditions, while the other contractors were unable to do so because of the difficulty of securing labor by the older methods, utilizing plows, scrapers and hand work.

E. I. du Pont de Nemours & Co.
Powder Makers Since 1802
Wilmington, Delaware

DU PONT

NOTE
When in Atlantic City, visit the Du Pont Products Store, Boardwalk and Penn. Avenue.

DU PONT

Mathews Gravity Carriers Save 1/3 in Labor

L. Ganett—Kent—Ohio.

"And they convey the brick to the setters clean and minus chipping and breakage. No more wheelbarrow gangs for us.

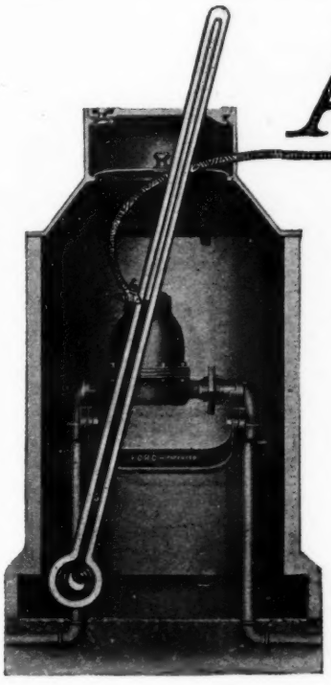
"Mathews Gravity Brick Carriers enable us to lay thirty thousand brick per day with six less men. The carriers are flexible and adaptable to all paving jobs."

Mathews Carriers operate by gravity (no power cost) and automatically (no labor cost). They are readily portable and are to be had in varying lengths.

Send for Bulletin No. 4.

MATHEWS GRAVITY CARRIER COMPANY
ELLWOOD CITY, PA.

Above Freezing



"This winter has been a severe one, and thousands of meters in surrounding cities have been rendered useless, as they have burst through freezing. We have over 400 outside installations, but they are housed in Ford Meter Boxes. We have so far not had a single frozen meter."

A mere meter box doesn't prevent zero weather, but **Ford Meter Boxes** *absolutely* protect your meters from freezing and tampering catastrophes! A **Ford Meter Box** isn't a promise—it's a *positive* guarantee!! It's the *only* meter box that really affords reliable anti-freeze insurance at *all* times and under *all* conditions! If you don't want a freeze—get a **Ford!**

Let us tell you about the Ford Yoke! Maybe you'll be interested in the Ford Stop Cock feature—of the inverted core type. It is "up and away" from the dirt, is always accessible—and in alignment, of full rated capacity and never sticks.

All Ford Meter Settings and accessories are made by practical waterworks men here in our own plant.

THE FORD METER BOX CO.
WABASH, INDIANA, U.S.A.

NEW PAVEMENTS FROM OLD ONES!

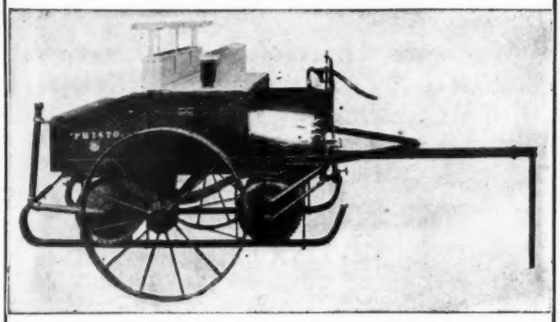
Resurface and Repair your old worn-out pavements with the **"Pluto"** Surface Heater. Removes 500 square yards, to a uniform depth of one inch, in eight hours. It carries 53 gals. of kerosene oil—the main tank, 35 gals.—the auxiliary tank 18 gals. When the large tank is empty, you can switch on to the small one and refill the other without stopping the work for an instant. Consumption, six gals. per hour.

"Pluto-A" is especially designed to operate *close* to the street car tracks without interfering with the traffic. Has a battery of three burners; heating capacity, 18 sq. ft. from 3 to 5 minutes. **"Pluto-B"** is designed for repairing "ruts" made in pavement by the continued travel of automobiles. It is six feet long by nine inches wide, has two burners, with a capacity of nine feet by ten inches in from 3 to 5 minutes.

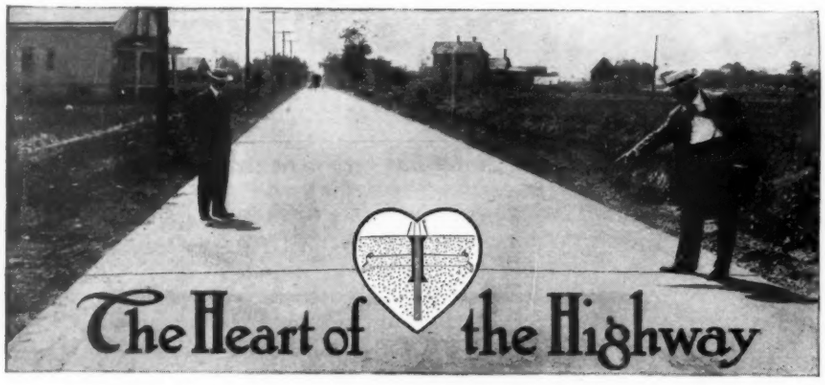
ALGER SUPPLY COMPANY

Peoples Gas Building **CHICAGO, ILL.**

The "Phisto" Tool Furnace, on a kerosene consumption of three gallons per hour, will keep fourteen tools, three pails of binder and three shovel scoops constantly hot. It gives a cleaner flame of more intense heat than can be produced by any wood-burning furnace and does away with the trucking of wood and ashes Recepticles at top for buckets, joint cement and shovel.



KAHN Building Products TRUSSED CONCRETE STEEL CO.

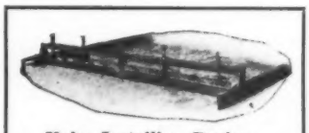


KAHN Building Products TRUSSED CONCRETE STEEL CO.

Kahn Armor Plates

THE joint in the concrete pavement determines its success. Protect the joint with the bevel-edged Kahn Armor Plates and you are sure the concrete cannot break down or chip away. Install the plates with our improved installing device and accuracy is assured. Reinforce the pavement with Kahn Mesh to prevent cracks in the roadway. If there are concrete curbs, reinforce and protect them with Kahn Curb Bars.

Kahn Road Mesh

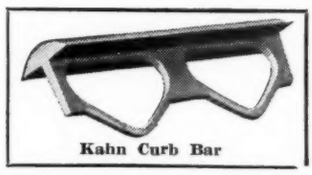

Kahn Installing Device

Kahn Road Book—a highway handbook—free on request. Write for our literature.

TRUSSED CONCRETE STEEL CO.

Highway Department **Youngstown, Ohio**

Representatives in Principal Cities.

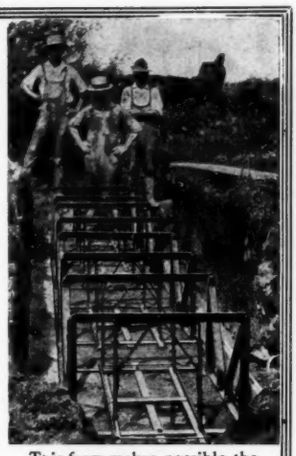

Kahn Curb Bar

We will demonstrate to the satisfaction of any State or County Official that

THE ONE MAN COLLAPSIBLE CULVERT FORM

(Adjustable for 39 Different Culvert Openings)

Will Cut Culvert Costs Tremendously

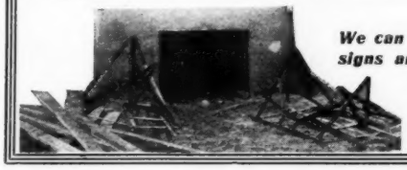


This form makes possible the Permanent Concrete Culvert at Small Cost.

Don't Specify or Build Culverts of any type until you have read our Booklet—sent on request.

Permanent drainage at reasonable cost is what you want. Our booklet shows you how to build Culverts from the smallest to the largest of **Concrete** at a surprising saving in cost over other methods. Metal Pipe, Vitrified Tile and Cement Tile are all compared and **figures given.** Write for the booklet. Sent without charge on request.

Storms Manufacturing Co. 52 West Van Buren St. CHICAGO, ILL.



We can also supply special designs and sizes of collapsible forms for storm sewers (leased on percentage basis).

Red for Danger!!

Ruby Globe by Day—Ruby Glow by Night—that warning signal enforces the "Rule of the Road"! It ***cautions.*** It ***warns.*** It ***protects*** both pedestrian and driver alike.

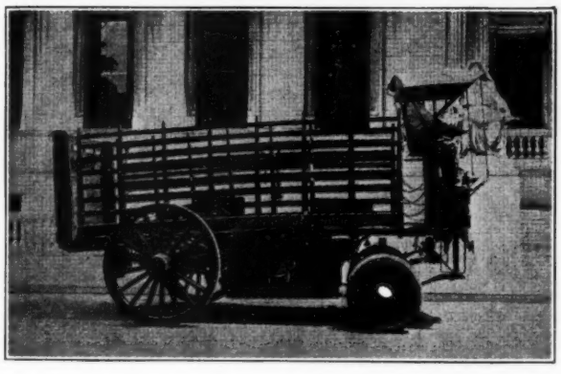
CUTTER
Traffic Signal Posts

Their "Keep to the Right" warning facilitates traffic movement at street intersections. And they are *"always on duty"*—rain or shine—summer or winter.

Our booklet gives details—write for it.

GEORGE CUTTER COMPANY
SOUTH BEND, IND.

Chicago Detroit New York
Los Angeles San Francisco Seattle



Couple-Gear Front and Four-Wheel Drive Trucks and Tractors are most economical in operation.

Let us tell you how you can efficiently motorize your old horse-drawn equipment.

We'll gladly send photos and complete typewritten descriptions (including cost figures) showing how leading contractors are cutting their motor haulage costs from 30 to 50 per cent via Couple-Gear. No obligation on your part.

COUPLE-GEAR FREIGHT-WHEEL CO.
GRAND RAPIDS, MICH.

Chicago Sales Agents—Couple Gear Power Truck Co.
1029 Peoples Gas Bldg.

ANNOUNCEMENT

On and after February 1, 1819, our general offices will be located at 7323 Woodlawn Ave., Chicago, Illinois, and we respectfully request all our friends and customers to address all communications to the Company at our new location after that date.

We shall continue to produce a full line of bituminous products of the highest quality, and asphalts for every purpose, and whenever you are in the market for paints, pipe coatings, expansion joint, mineral rubber, insulation compound, filler, road asphalt, roofing cement, waterproofing, or any other bituminous products of similar nature, kindly give us an opportunity of figuring with you on your requirements.

Our Policy—"A Personal Interest in Every Order; an Earnest Endeavor to Please."

The Pioneer Asphalt Co.

Producers of Highest Quality Bituminous Products.

Chicago, Ill. **Lawrenceville, Ill.**

KOEHRING

The Koehring Boom reaches up alleys and intersecting streets —a big time-saving *every time.* It is a time saver all the time, because it means a power-driven distribution of concrete, and gives the greatest distributing range without moving the mixer. Extra automatic actions exclusive to a Koehring boom and bucket system enables operator to give on-time attention to every duty and deliver top speed of mixer as a unit. The Koehring Paver with liberal drum dimensions, double wide high angle charging skip, fast discharge, boom and bucket distribution and heavy duty construction throughout, means *lowest yardage cost.* Write for booklet *U-1.*

Koehring Sizes in Cubic Feet Capacities

Mixers for construction work; 10, 12, 15, 20, 24, 30, 44. Equipped with low charging hopper, batch hopper and side loader.

Hot Mixers for Bituminous Pavements: 12, 20, 22. Side discharge type and end discharge type.

Paving Mixers: 5, 11, 16, 22. Equipped with distributing boom and bucket or spout.

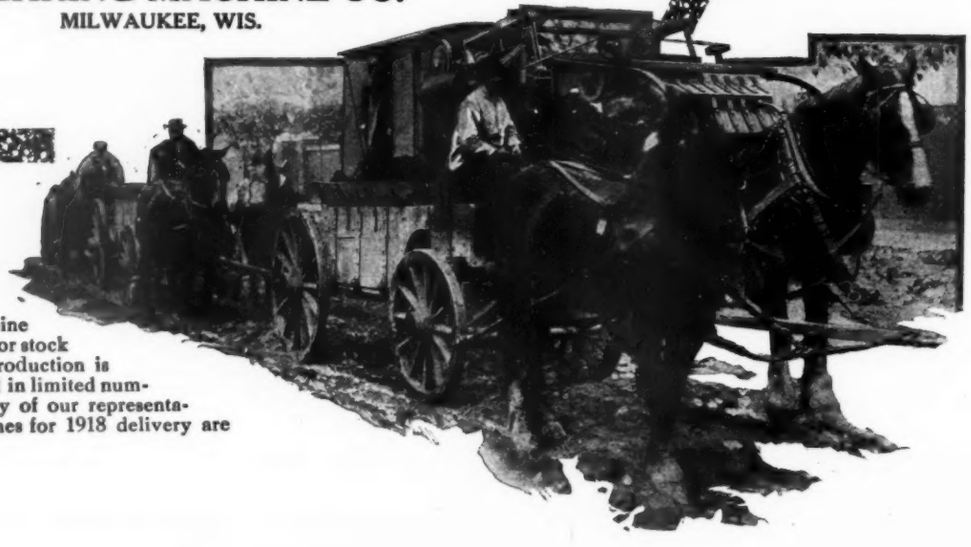
Gasoline Power, Steam power or Electric power.

DIGS TO GRADE AND LOADS 60 TO 100 CU. YDS. PER HOUR.

Digging wheel adjustable to cut from two inches to two feet—speed ahead regulated according to depth of cut. Tough clay has been dug to grade and loaded at .043 per cu. yd. Will dig out old macadam, and with screen attachment, will separate stone. This is a one-man machine—a revolutionizing cost-cutter for street and highway grading. Write for booklet *U-2.*

KOEHRING TURBINE GRADER

KOEHRING MACHINE CO.
MILWAUKEE, WIS.



The Koehring Turbine Grader is not built for stock —only to order—production is limited and allotted in limited number to each territory of our representatives—a few machines for 1918 delivery are still available.

The Highway Economist

VOL. III. MARCH, 1918. No. 10.

HIGH ARMY OFFICERS FAVOR CONTINUED ROAD BUILDING

Maj.-Gen. Leonard Wood, former chief of staff, is one of the most distinguished of living American soldiers. General Wood has a characteristic habit of expressing his opinions tersely and emphatically. This outspeaking habit has at times brought him into conflict with higher authorities, but that fact has in no wise affected his penchant for saying bluntly just what he thinks ought to be said.

General Wood takes little stock in the idea that there should be a general curtailing of road building. Contrariwise, he emphatically urges renewed activity in road building.

General Wood says:

"Of course, war demands a nation's entire resources, and the most efficient means of delivering them are needed. Thus, a systematic, well-planned network of roads which can be regularly used commercially is not only a good investment, but it may be of tremendous value to our military forces. While hastily or improperly built roads should not be rushed at this time, on the chance that they might be of some strategic value to our armies, substantial highway construction of economic value should not be curtailed because we are at war.

"The requirements of the wearing surface for military purposes may be stated as: (1) absolutely dependence in all kinds of weather, in all seasons of the year, under the most severe usage; (2) wear resistant, so that extensive or frequent repairs or maintenance may not be necessary; (3) easy and quick to repair without interrupting traffic and with simple tools and materials; (4) low in tractive resistance; and (5) offering a good foothold for horses and a good grip for rubber tires, and at the same time smooth enough to allow a good rate of speed for motor trucks. * * *

"Only the highest type of standard pavement surfaces answers these requirements completely. * * * The block pavements, such as stone or vitrified brick are probably the best types.* * *

"Methods of construction or types of surfacing which are used to cheapen the first cost at the expense of the requirements stated above should not be used. They are also proving uneconomical under modern commercial traffic."

Vitrified brick pavements constructed so that all parts are united in a single rigid beam, fulfill all the requirements as no other pavement does.

Brick withstands abrasion even better than stone, and it gives a smoother, more even wearing surface, offers less tractive resistance and is cleaner than any other surfacing material. Brick neither ruts, pits nor disintegrates under traffic or by reason of the action of the elements, oils or acids. Given an even, stable and well-drained foundation, and built of rigid beam design, a brick pavement is never worn out by traffic. It is the only surfacing not affected by the elements.

A brick pavement is not slippery; it gives rubber tires a good grip yet does not pull on them by suction nor grind them by means of particles of material, and therefore it prolongs the life of rubber tires.

The Indianapolis speedway, built of vitrified brick, demonstrates the non-skid qualities of brick and at the same time proves its high-speed possibilities and invulnerability to the effects of rubber tired vehicles moving with great velocity.

In loading capacity, brick, inch for inch of depth, is equalled only by granite block. Tests have shown that a 4-in. grouted brick slab, without any foundation course, and supported only at either end, will sustain a load of 5,000 lbs. to the square inch, applied at the third points, before breaking. This being true, the non-abrasive character of vitrified brick makes it, when laid on a solid foundation, the most durable of all general purpose pavements.

Other High Military Commanders Urge Continued Road Building.

Military authorities are alive to the vital necessity for continuing road building as a means of rapid and uninterrupted concentration and distribution of commodities and materials. Hon. Newton D. Baker, Secretary of War, is urging prompt completion of unimproved sections of through routes.

General Black on Comprehensive System of Military Highways.

Maj.-Gen. W. M. Black, Chief of Engineers, U. S. A., in a letter to William D. Sohier, Chairman Massachusetts Highway Commission, dated Nov. 26, 1917, said in part:

"As to the question of what military roads must be prepared to carry in the way of traffic, it may be stated that our existing ordnance liable to accompany a field army will have its heaviest representative in a 12-in. howitzer weighing about 27,000 lbs., 18,600 lbs. of which are on the front whels and the remainder on the two back wheels. The wheel base or distance between the front and rear axles is 18 ft.; width of track, 7 ft. 4 ins.; width of tires, 8 ins.; width of tire shoes, 12 ins. This howitzer is to be drawn by a 75-hp. caterpillar tractor weighing about 25,000 lbs. Comparison with the largest present-day commercial trucks shows that a road substantial enough for such will suffice for the ordnance load, so that in this particular as well as in a strategic way roads suitable for commercial purposes will meet the military requirements.

"In short, it is the opinion of this office that any road that will serve for present-day commercial motor transportation will be satisfactory for prospective military traffic of all classes.

"As you are probably aware, there were introduced at the last Congress two bills (Senate Bill No. 2470, by Senator Chamberlain, and House Bill No. 5161, by Representative Dent) which provided

for a comprehensive system of military highways for the United States. It is believed that it is only in some such way as this that the problem of military highways will ever be satisfactorily solved, that is to consider the needs of the United States as a whole, to work out a project to meet such needs, and to complete such project in the order of the relative importance of the roads making up that project."

Maj. Bond on Roads as National Requirement.

Maj. P. S. Bond, Corps of Engineers, U. S. A., an officer of marked distinction, gives this opinion regarding road-building as a national requirement:

"The motor car saved Verdun to France. But there is one highway in France which enjoys the same distinction. For three months, 24 hours a day, an endless procession of motor trucks, two abreast in each direction, traveled this highway going to and from Paris.

"Without transportation an army is helpless, and transportation is impossible without suitable military roads. It is, therefore, essential that roads should be laid out and constructed with a view to military use as well as to the uses of peace, especially on frontiers most likely to be the scene of military operations. A little intelligent forethought and supervision by the Federal authorities would meet military needs with comparatively slight increase in expense.

"It is of great importance, also, that there be no weak links in our distribution system. Troops and supplies will move both perpendicularly and parallel to the line of battle, and both cross and parallel roads should be paved. A section of unimproved road on an otherwise well-paved route might become impassable for large trucks, thus nullifying the military value of the entire stretch of road.

"Good roads and railroads increase the useful productive capacity of our mines, fields and forests. Every road in every part of the land which connects a producer of any commodity with a shipper or consumer of that commodity will play its part in enabling the nation to bring to bear its full strength in armed conflict, and the better the road the more perfectly it plays its part. Therefore, every good road which is a necessary artery of supply or travel, as distinguished from purely pleasure routes, is an essential part of the system of national defense, even though it be not located in the theater of actual military operations.

"A country-wide system of military roads, with a marginal highway around the entire country, will do much to solve the problem if it is properly prosecuted. Our splendid railroads will be of little use to us unless we complete our distribution system and are prepared with good trucks and good roads to distribute supplies to the points where they are needed."

Enormous Loads to Be Carried.

Mr. W. D. Sohier, Chairman of the Massachusetts Highway Commission, a recognized authority on roads, says:

"While the railroads and steamships are vitally necessary to bring the supplies and men, ammunition to the artillery, and everything needed for modern war, to the country, and from the large storehouses to the railroads, the soldiers in the trenches, and more particularly the soldiers back of the trenches that are holding the long battle lines, have to be almost entirely supplied over the roads.

"I fear the people in this country, and particularly our legislators, are not really awake to the tremendous importance of good roads if this country is to do its part in the world's war. They are

Fourth Street, Marion, Ind., paved in 1891, with Metropolitan Paving Brick, ***has withstood*** the heavy poundings of traffic for 27 years and it is still in ***good condition.*** (Ask the other fellows to show you a street like this.)

Metropolitan

Repressed and Wire-Cut Lug

Metropolitan Shale required centuries of Natural ageing to come to its full perfection! Mother Nature's slow, patient process gave us a Time and ***Wear-Resisting*** shale that explains why Metropolitan is the "Best Paving Block Made." It is the ***standard*** by which all other paving block is judged.

THE
Metropolitan Paving Brick Co.
"The World's Largest"
CANTON, OHIO.

important, not only from a strictly military point of view, but they are absolutely essential if the country is going to grow and harvest its crops, and supply not only our own soldiers but our allies with the food that they can not live without.

"The experience of England and what she has done since the war started, on her highways, is perhaps the best example that we could follow. England has not been invaded, but she has had to enlist, train and equip large armies, has had to organize to make tremendous numbers of guns, enormous quantities of ammunition and supplies of every kind.

"It is very significant that she, with her tremendous network of railroads and small area, has found that her roads, especially the main roads, were of vital importance. With all the tremendous additional expenditures made necessary by the war, and with undoubtedly a large number of the uninformed public saying that she must save every dollar possible—why not stop some of the expenditures on roads?—she has not only not stopped these expenditures, but has actually increased them in many places.

"Certainly all highway authorities should cooperate to the utmost of their ability in building and maintaining the roads which are of vital necessity to this country.

"No doubt as our railroads are becoming congested, and it will take considerable time before they are enlarged sufficiently to take care of the traffic, the highways will have to do more and more of the transportation of the country.

"We must realize the tremendous traffic that any road which is supplying an army or is near an army post must carry, and build the roads and bridges accordingly."

Robbins — Coaldale — Graves

Wire-Cut Lug Brick

When you lay *Wire-Cut Lug Brick* streets or roads, you can spend your maintenance fund in getting new mileage, not tinkering the old.

Southern Clay Mfg. Co.

CHATTANOOGA, TENN.

Springfield Wire-Cut Lug

IS WIDELY USED

The square edges *stay* square, due to the spacing lugs and beveled ends. Both Dunn Wire-Cut Lug and Frost Process. Sewer and Building Brick—also very artistic Rug Face Brick.

Springfield Paving Brick Co.

SPRINGFIELD, ILLINOIS

MEDAL BLOCK
"The Block with Experience behind it"
BUYING cheap goods to save money, is like stopping the clock to save time; and this applies to many types of road surfacing material. If you want the only sure, durable and reliable road surface, buy
MEDAL BLOCK
"The Block with experience behind it"
Manufacturers of Medal Block for 23 years.
Manufacturers of Paving Brick for 29 years.
Oldest in service unexcelled in quality.
Medal Repressed, Wire-Cut-Lug and Hillside Block.
23 YEARS SERVICE
Capacity 55,000,000 annually.
THE MEDAL PAVING BRICK COMPANY
FORMERLY THE DECKMAN-DUTY BRICK CO.
1305-1308 Swetland Building
Cleveland, Ohio

BACK TO BRICK!

IT STANDS THE TEST OF TIME!

Ancient Records and Modern Paving Show Brick's Durability

Military Leaders Demand Enduring Pavement

Victory for American arms, sound public policy and patriotic duty alike demand a network of dependable roads, serviceable every day in the year.

The enormous weight and volume of traffic requires the most durable type of road.

Vitrified brick is the most durable manufactured product known to man.

Commercialism and the urge of inventive impulses have evolved many substitutes for brick road surfacing. But Brick excels them all under the supreme test of modern service.

Back to Brick is becoming recognized as a necessity. ***"Build durable roads"*** is the plea of men who realize the critical situation.

Major P. S. Bond, Corps of Engineers, U. S. A., says: "Every road in every part of the land which connects a producer of any commodity with a shipper or consumer of that commodity will play its part in enabling the nation to bring to bear its full strength in armed conflict."

Maj.-Gen. Leonard Wood, U. S. A., declares: "Wearing surfaces which are not suitable for our cities will not stand up under concentrated highway traffic. The block pavements such as ***stone or vitrified brick are probably the best types."***

Wire-Cut Lug Brick are the highest type of vitrified brick for all paving for heavy or light traffic —streets, highways, boulevards, factory and mill floors, yards, platforms, etc. Pavements designed to meet varied requirements.

Our corps of engineers of national reputation will assist you on your paving problems.

Write for additional information.

—LICENSEES—

Corry Brick and Tile Co., Corry, Pa.
United Brick Co., Greensburg, Pa.
Sterling Brick Co., Olean, N. Y.
Danville Brick Co., Danville, Ill.
Clinton Paving Brick Co., Clinton, Ind.
Alton Brick Co., Alton, Ill.
The Medal Paving Brick Co., Cleveland, Ohio.
Metropolitan Paving Brick Co., Canton, Ohio.
Peebles Paving Brick Co., Portsmouth, Ohio.
Murphysboro Pav. Brick Co., Murphysboro, Ill.
Southern Clay Mfg. Co., Chattanooga, Tenn.
McAvoy Vitrified Brick Co., Philadelphia, Pa.
Windsor Brick Co., Akron, Ohio.
Hocking Valley Brick Co., Columbus, Ohio.
Veedersburg Paver Co., Veedersburg, Ind.
Springfield Paving Brick Co., Springfield, Ill.
Terre Haute Vitrified Brick Co., Terre Haute, Ind.
Albion Vitrified Brick Co., Albion, Ill.
Alliance Clay Product Co., Alliance, Ohio.
Westport Paving Brick Co., Baltimore, Md.
Mack Mfg. Co., New Cumberland, W. Va.
Hydraulic-Press Brick Co., St. Louis, Mo.
Barr Clay Company, Streator, Ill.
Trimble Paving Brick Co., Dayton, Ohio.
Thornton Fire Brick Co., Clarksburg, W. Va.
Indiana Paving Brick & Block Co., Brazil, Ind.
Standard Brick Co., Crawfordsville, Ind.
Shawmut Paving Brick Works, Shawmut, Pa.
Pennsylvania Clay Co., Pittsburgh, Pa.
Clydesdale Brick & Stone Co., Pittsburgh, Pa.
The John Kline Brick Co., Wickliffe, Ohio.
Streator Clay Manufacturing Co., Streator, Ill.
Martinsville Brick Co., Martinsville, Ind.
Cleveland Brick & Clay Co., Cleveland, Ohio.
Jamestown Shale Pav. Brick Co., Jamestown, N.Y.
Purington Paving Brick Co., Galesburg, Ill.
Georgia Vitrified Brick & Clay Co., Augusta, Ga.
F. R. Carter, Peoria, Ill.
C. P. Mayer Brick Co., Bridgeville, Pa.
Athens Brick Co., Athens, Ohio.
Albion Shale Brick Co., Albion, Ill.
Copeland-Inglis Shale Brick Co., Birmingham, Ala.
Brick, Terra Cotta and Tile Co; Corning, N. Y.
Medora Shale Brick Co., Medora, Ind.
Binghamton Brick Co., Inc., Binghamton N. Y.
Municipal Shale Br'k & Bl'k Co., Martinsb'g, W.Va.
Lake Shore Shale Brick Co., Ashtabula, Ohio.
Allegany Valley Brick Co., Olean, N. Y.

Write for data.

THE DUNN WIRE-CUT LUG BRICK CO., Conneaut, Ohio.

(LICENSORS)

MOTOR TRUCKS

Motor Trucks as Operated in the Intercity and Interstate Haulage of Freight on the Highways.

(SECOND INSTALLMENT)

ACME 5-TON TRUCK AS OPERATED IN INTERCITY AND INTERSTATE HAULAGE BY THE M'GANN CO., TRANSFER AGENTS AND WAREHOUSEMEN, NEWARK, N. J.

Printed as insert to Municipal Engineering, March, 1918.

Mack TRUCKS

Making Short Hauls Pay

Quick unloading solves the short haul problem.

On jobs where ordinary trucks would be unprofitable, MACK trucks equipped with hydraulic hoists have proved to be money-makers.

The body is elevated to an angle of 50°. At this pitch a load slides off easily whether it be sand, crushed stone, wet concrete or hot asphalt.

But of greater interest to contractors is the MACK truck's tremendous strength, its great brute power, its low cost of operation and upkeep and its long life.

MACK trucks were used by the builders of the great Roosevelt Dam. Also on the New York Subway, Croton Aqueduct and many another important engineering job.

Investigate the records of MACK trucks. Learn how they have cut hauling costs. We have facts and figures. Send for them.

1 to 7½ tons capacity; with trailers, to 15 tons. Bodies can be designed to meet special needs.

INTERNATIONAL MOTOR COMPANY
NEW YORK

Performance Counts

Breaking Down the Transportation Question

The serious question blocking American business today is transportation.

Garford Motor Trucks are breaking through the freight congestion and assisting in bringing order and profit out of chaos for others.

Why not for you?

Your orders tied up in "No man's land" of shipping delays are losing money for you and for your customer.

Your problem is no longer one of producing, it is delivery.

Garford Motor Trucks, from one to six tons, are delivering products in the shortest possible time, at the lowest possible cost, with the least possible wastage.

They are dependable, efficient and durable freight haulers.

Let our transportation experts help you at once.

You are doing business with a known quantity when you depend on Garford.

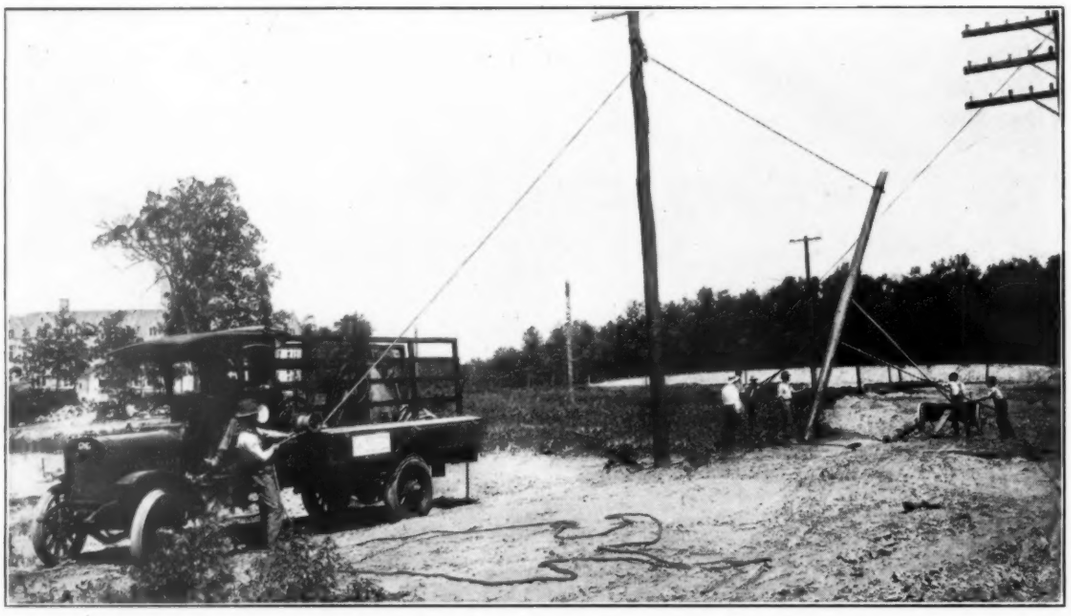
The Garford Motor Truck Company, Lima, Ohio

Manufacturers of Motor Trucks of 1, 1½, 2, 3½, 5 and 6 ton capacity. 4½, 7 and 10 ton Tractors

The Garford Road Builder

Address Department 107.

GMC
TRUCKS



GMC Trucks Provide Pulley Power

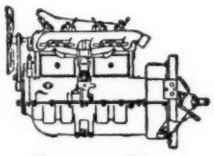
THIS picture conveys an idea of the broad utility of the GMC Truck, and shows the kind of work it does with the "Take-off" winch attachment.

The winch device can be attached to any GMC Truck, and it is very simply operated. A mere shifting of a selective gear from the driver's seat throws the winch into gear with the powerful motor, and a giant power is ready to pull for you.

In loading heavy machinery on a truck and for many other uses, the winch will do the work of several men. It is a labor saver, a time saver, and a money saver.

This is only one of the many features that have made the GMC Truck conspicuous for merit in construction and complete dependability in every detail. It is a combination of perfect units built by master workmen in a factory where truck building is and always has been the sole industry.

Order your next GMC Truck with a winch attachment or add this inexpensive feature to your present equipment. You will find it a profitable investment.



Power Plant

The source of power—the heart of the mechanism—a GMC engine is built for greater strength and endurance than will ever be called for during its life.

GMC engines are simple in construction and dependable in service. Three point suspension guarantees against strain. Adjustable parts are easily reached.

GENERAL MOTORS TRUCK COMPANY

One of the Units of the General Motors Corporation

New York Philadelphia Boston **PONTIAC, MICH.** Chicago St. Louis San Francisco

Distributors most Everywhere (315)

MOTOR TRUCK OPERATION AND ACCOUNTING XXXI.

By Charles A. Dickens

(Continued from February Issue)

Truck Fleets Are to Carry Freight from Chicago to New York

Definite arrangements have been made by Master Trucks, Inc., Chicago, to inaugurate a regular motor truck commercial freight-hauling service between Chicago and New York. Announcement was recently made by Eugene Goldman, vice president and general manager of Master Trucks, that the pilot truck and a number of others that will make up the fleet are ready for service just as soon as the roads will permit of heavy hauling. A separate organization to be known as the Master Truck Transportation Company, an Illinois corporation with a capital stock of $250,000, has been formed to operate this new service, the prime thought being aid to the hauling facilities of the railroads.

By the time the weather moderates sufficiently for the roads to become passable, the first fleet of 24 internal gear-driven 2-ton Masters will be ready to make its pioneer journey. Some 3½ ton worn-drive Masters probably will be included in the service. All will have special bodies of the stake type with tarpaulin covers, the loading capacities being 12x6x6 ft. Other minor changes will be made in the motive equipment to blend with the freight-carrying plan.

The route of this new freight-carrying line, which is an innovation in long-distance hauling, will include Chicago, South Bend, Bryan (Ohio), Toledo, Cleveland, Erie (Pa.), Buffalo, Rochester, Syracuse, Utica, Albany, Poughkeepsie and New York. One feature of the trucks will be the pneumatic tire equipment, with the use of which the company plans a speed for its trucks of 25 to 35 miles per hour. Special changes in construction to permit of this speed, which is high for average truck work, have been made.

Some idea of the thoroughness of the preparations will be gained from the fact that the fleet will have with it one truck devoted entirely to the carrying of oil and gasoline for the use of the trucks in the convoy. Another truck has been equipped as a kitchen to prepare meals for the drivers and mechanics en route, while a third will carry tents and sleeping equipment for the men. From this it is evident that there will be no necessity for depending on any hotel or restaurant accommodations.

All the hauling will be done under contracts and there will be no "less than truckload" shipments taken. Further, these full loads must all go to one destination. There will be no intermediate stations for the present, shipments being taken only for Buffalo and New York delivery at first. Contracts also have been signed to insure full loads for the trucks on the return trips.

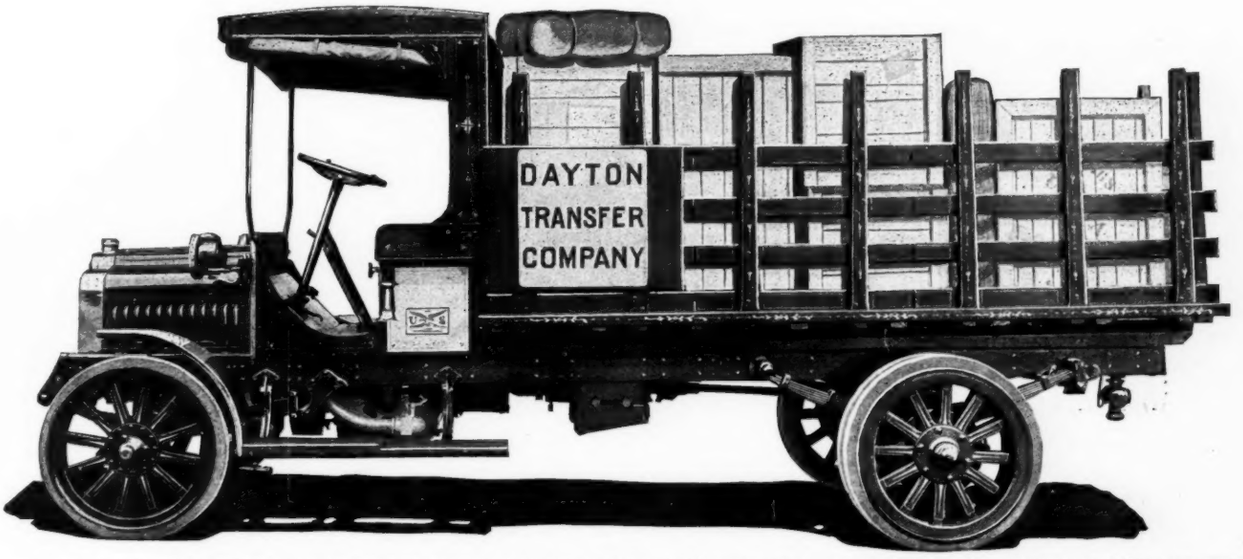
The trucks will run in convoy formation and ten or eleven hours will constitute a days' run. The drivers that start will continue with their trucks throughout the trips. The character of freight to be handled will include anything that can move via a truck of the capacities mentioned.

The rates for hauling will be the same as for express, but there will be the added feature that the power that carries the shipments across the country will deliver it at the door of the consignee. Present plans do not include way stations for concentrating freight or for unloading for further distribution. By handling all this business under contract there will be no necessity for interstate commerce commission regulation.

According to Mr. Goldman, this method of freight transportation will become general with other truck concerns, for already the company just formed has had requests from more Chicago and New York manufacturers to make deliveries betwen these two points than a fleet three times the size of the one contemplated could handle.

Performance of a Mack Truck

A 3½-ton Mack truck under full load made the overland trip from New York City to Akron, Ohio, a distance of 533 miles, in 60 hours; actual running time, 49 hours. The temperature at the time was 13 degrees below zero and the roads were covered with snow. This truck is to make regular trips

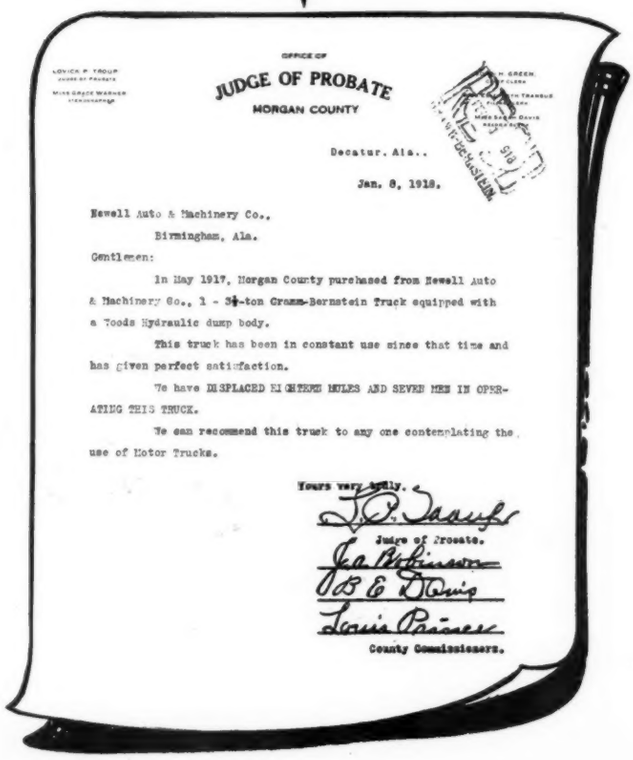


U. S. 2½-TON TRUCK AS OPERATED BY THE DAYTON TRANSFER CO., DAYTON, OHIO. DURING ONE OF THE HEAVIEST SNOWSTORMS OF LAST WINTER THIS TRUCK WENT FROM DAYTON TO KING'S MILLS AND BACK, A DISTANCE OF 66 MILES.

MORGAN COUNTY
THE GRAMM-BERNSTEIN MOTOR TRUCK COMPANY—LIMA, OHIO, U.S.A.
GRAMM
BERNSTEIN
MANUFACTURERS OF HIGH GRADE WORM DRIVE MOTOR TRUCKS — ONE TON TO FIVE TONS

The Commissioners of Morgan County, Alabama, decided to purchase a motor truck; various makes at different prices were offered them. They were attracted by the exceptional features in the **Gramm-Bernstein.**

NOTE THEIR SATISFACTION



OFFICE OF
JUDGE OF PROBATE
MORGAN COUNTY

Decatur, Ala.,
Jan. 8, 1918.

Newell Auto & Machinery Co.,
Birmingham, Ala.

Gentlemen:

In May 1917, Morgan County purchased from Newell Auto & Machinery Co., 1 - 3½-ton Gramm-Bernstein Truck equipped with a Woods Hydraulic dump body.

This truck has been in constant use since that time and has given perfect satisfaction.

We have DISPLACED EIGHTEEN MULES AND SEVEN MEN IN OPERATING THIS TRUCK.

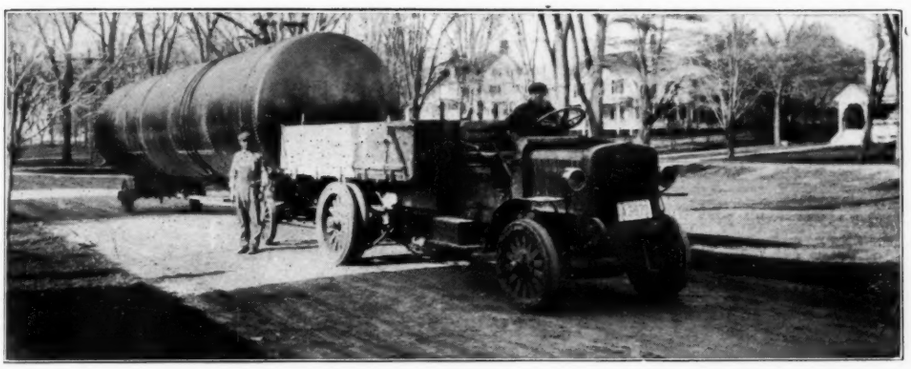
We can recommend this truck to any one contemplating the use of Motor Trucks.

Yours very truly,
T. P. Isaacs
Judge of Probate.
Jas Robinson
J. B. E. Davis
Louis Parmer
County Commissioners.

Twenty years' experience as exclusive truck builders has permitted us the highest efficiency in the solving of transportation problems. Practical features—quality material—proper designing with a guarantee broader than any other known in the industry, insures the purchaser the very lowest maintenance and operating cost. Dependable and accurate operating cost data applying on Gramm-Bernstein motor trucks engaged in over one-hundred different lines of work sent on request.

The Gramm-Bernstein Motor Truck Company

LIMA, OHIO.



GENERAL MOTORS 3½-TON TRUCK HAULING 9-TON WATER TANK FOR L. E. RAGAN, CONTRACTOR, CHATHAM, N. Y.

between Akron and New York and Boston for the Goodyear Tire and Rubber Company. The truck is shod with large pneumatic tires; front tires, 7 ins., and rear tires, 10 ins.

Gary Trucks on Long-Haul Work

The truck operated by the South Shore Motor Express, a Gary Model K, herewith illustrated, is used almost exclusively for long-distance hauling in handling freight between Gary, Ind., and all parts of the city of Chicago. Several other Gary trucks are being used for the same purpose with eminently satisfactory results.

Yates Bros.' Transfer and Express, Joliet, Ill., are also using Gary trucks on long-haul work, some of the trips they are making being good long ones. Other transfer companies, as well as several of the different oil companies, large packing companies and breweries, are using Gary trucks in intercity haulage with results that are decidedly satisfactory to them.

187 Miles Through Snow in 15 Hours

A Maxwell truck, the Camp Sherman special, early in January, ran through heavy snowdrifts from Toledo to Camp Sherman, a distance of 187 miles, in 15 hours. This was a 1-ton truck carrying 2,900 lbs. of supplies.

Experience of McGann Co., Newark, N. J.

The illustration on the first page of this motor truck section shows a 2-ton Acme truck as operated in intercity haulage by the McGann Company, transfer agents and warehouse men, Newark, N. J. They operate a fleet of Acme trucks in and around Newark in intercity and interstate haulage and have done much to relieve railway congestion in that populous region. Their fleet of several trucks has grown in this service from a single unit and the inference is plain that they have found plenty of hauling of this class to be done at a good profit.

25 Service Trucks Operated by Motor Transfer Co. of Chicago

The Motor Transfer Company of Chicago made its initial purchase of three Service motor trucks in May, 1915, and since then the fleet has grown to include 25 trucks, including every Service model except the one-ton truck. The oldest trucks have, for over two years, been handling the daily delivery of merchandise for the largest department store in South Chicago, without a hitch, over all kinds of roads, in all kinds of weather.

Little Giant Trucks in Intercity Service

Irwin Brothers, provision dealers, regularly operate two Little Giant 2-ton trucks between Chicago and the Great Lakes Naval Training Station at Great Lakes, Ill. They have used a Duntley hydro pneumatic gas generator and it makes a big saving in mileage and power. They use gasoline, a mixture of half and half and clear kerosene. In using clear kerosene they save over 75 per cent in operating their cars. The Duntley device eliminates smoke and odor and introduces no starting trouble. They make three drives per week over this route, the distance one way being 40 miles. They habitually, through necessity, load the 2-ton truck at three tons. They make the round trip, 80 miles, on 8 gals. of a 60-40 percent mixture of kerosene and gasoline at an average of 10 miles per gallon, the round trip costing $1.06 for fuel.

J. C. Kubias, Redlands, Calif., has a Little Giant truck in constant service. During a recent week they made three trips with loads of olive oil, weighing 3,000 to 3,300 lbs. per load, to Los Angeles via Pasadena, and returned the same day. The 160 miles were covered in 12 hours and the elevations varied from 1,362 ft. to 26 ft. above sea level.

Using Federal Trucks in Intercity and Interstate Haulage

The following examples of the use of Federal trucks in intercity and interstate haulage are given by L. B. Dudley, advertising manager of the Federal Motor Truck Co:

Even railroad operators are coming to understand that the motor truck is the solution to the congestion problem. Motor trucks operated on intercity and interstate haulage up to a certain distance will relieve this congestion, throw a great number of freight cars into long distance haulage service, reduce the haulage cost of the people, and increase

GARY 3-TON TRUCK MOTOR EXPRESS BETWEEN GARY, IND., AND ALL POINTS IN CHICAGO.

U S MOTOR TRUCKS — FLOATING POWER PLANT

High Earnings in the Contracting Business

A U. S. truck in the service of T. R. McGrath, a builder of Germantown, Philadelphia, Pa., has shown a high record of earnings since it went into service.

This success has led the owner to install another and similar truck.

The truck has run steadily. Only twice has it been in the shop for adjustment and minor repairs. It has carried heavy loads over very bad roads. It has pulled out of places where other trucks were stalled, and has worked when other trucks were stopped.

The truck has brought more work to its owner than he can do. It operates at a cost of about $4.00 a day, not including fixed charges.

Builders and contractors everywhere report similar experience with the U. S. They credit much of its unusual ability to the Floating Power Plant.

WRITE FOR THE FACTS.

Worm Drive—2½, 3½ and 5-ton.
Chain Drive—2½ and 3½-ton.

The United States Motor Truck Co
CINCINNATI

MASTER 2-TON TRUCK AS OPERATED BY DIEDERICH & ROGERS, CARTAGE CONTRACTORS, IN INTERCITY HAULAGE.

the earnings of the railroad by permitting freight cars to make more trips.

Take, for instance, the Boston & Albany Railroad of the New York Central Line. Congestion on this line at West Springfield was as evident as elsewhere until a 2-ton Federal was placed in service in June, 1917. One of the officials tells the story as follows:

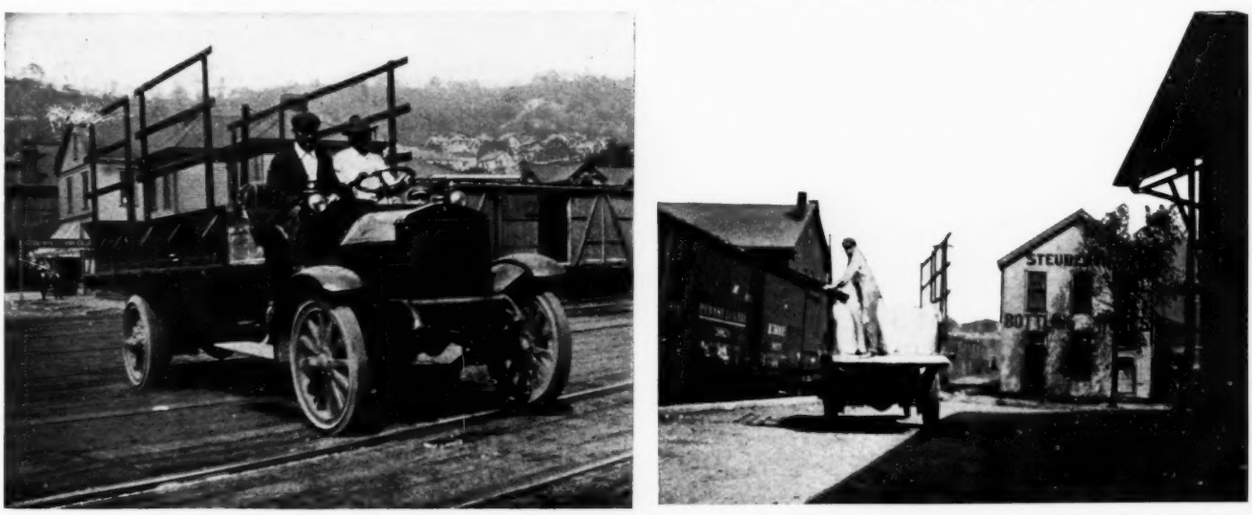
"Previous to the arrival of our Federal truck our trucking was handled through different trucking concerns in and about Springfield. Since this new truck has been in operation we have done away with all trucking charges, which amounted to at least $75 per month, and done away with the use of an engine which it was necessary to have in handling material between Springfield and West Springfield. It also has saved a great deal of demurrage through our being able to handle material between the storehouse at West Springfield and the freight house at Springfield. We also saved considerable time in emergency cases when material is desired at different points at once." This truck has, among other things, released an engine and a number of cars that are now being used in longer runs. The motor trucks have saved the day for the B. & A.

Another instance that comes to mind is that of the San Diego and South Eastern Railroad in Lower California. This company utilize trucks as feeders to their roads. Their first truck, a 3½-ton Federal, was put in service last August, being used on a 34-mile wood haul. It hauled four cords of wood per trip and traveled 5,600 miles the first three months. Their second truck, a 3½-ton Federal, has been used in hauling various products and has been doing its bit to win out in the war with congestion.

Among those who early realized the advantages of Motor Truck Freight Lines was Mr. L. O. Ginnochio. In 1916 he started a freight line between Reno and Gardnerville, Nev. Over 104 miles of mountain road separates these cities. Each of Ginnochio's Federals makes one trip per day. During one week recently he reported for one of his 2-ton trucks seven trips made, 20.2 tons hauled, 728 miles traveled and a total cost of $93.59. This freight was carried for $8 per ton, bringing in a total for the week of $161.76.

W. B. Ensign was another pioneer of the intercity haulage movement. He has operated his Federal down in Ohio, using Alliance as a center, and visiting nine Ohio and three Pennsylvania counties regularly. Trips to Cleveland, Akron and Canton are most frequent, his trucks rarely traveling less than 100 miles per day. Mr. Ensign says: "We find the cost to customer of shipping by motor trucks up to a distance of 50 or 60 miles to be about the same as by railroad. But if a money value is placed on the days the customer is without his goods, the time necessary when he ships by railroad, the motor truck way is the better even to a distance of 100 miles or more."

Another such company is the Lee Bros. Company at Santa Rosa, Cal. Their hauling consists chiefly of trips between Santa Rosa and San Francisco, a trip of over 80 miles, which their 2-ton Federal has made with ease, even though but eight miles of the roadway is paved.



FEDERAL 2-TON TRUCK AS OPERATED BY FRALEY & RUNYON, STEUBENVILLE, OHIO, IN REMOVING FREIGHT CONGESTION BY HAULING FROM DEPOTS TO MERCHANTS.

Weigh Your Haulage by this Standard

-20% Super Strength!
-11% Greater Power!
-Greater Loading Length!
Extra Deep and Extra Heavy Steel Frames with Wider Flanges!
-Specialized Construction!

Service MOTOR TRUCKS

Occupy the strongest position among the "Dominant Ten" truck manufacturers whose products find largest sales among careful buyers.

The most rigid tests (under extreme driving and load carrying conditions) have proven that **Service** trucks have *20% greater strength* in every detail of design (without excess weight). That's why **Service** Motor Trucks operate continuously night and day for months without a cent's worth of repair costs due to breakdowns.

The Service power plant in excess of requirements and equal to any emergency develops *11% greater power* than any of the other *"Dominant Ten"* Motor Trucks. That ample reserve of dependable power takes your load "over the top" of the steep climbs, no matter the grade or condition of roads.

Each and every part of **Service** Trucks is not only over-size but is most carefully constructed from only the highest quality of materials obtainable. Each separate ***Service*** part is so proportional that it bears its share of the load and does its share of the work without overload or undue strain. ***Service*** trucks are built to stand the grind and hold down the up-keep charges—and they do! That's why they give years of unflinching and genuine service at the lowest cost per ton-mile.

Service Motor Truck Co.
WABASH, INDIANA.

SERVICE TRUCK AS OPERATED IN THE INTERCITY HAULAGE OF CONSTRUCTION MATERIAL.

The district traffic superintendent of the Bell Telephone Company at Pittsburg, Pa, recently wanted to move his household goods to Trenton, N. J. He believed that motor trucks could get the goods there in better time than railroads. The Weber Express Company assured him that their Federal would take his goods there, even though it meant a haul of 375 miles. The actual running time for this 375 miles over the mountains was 44 hours and 45 minutes. The return trip was made in 36 hours. Truly the motor truck is the business man's friend.

Jesse Wilson found it necessary to make regular trips from Okanogan to Republic, Wash., a distance of almost 80 miles. His 4-horse team required 5 to 5½ days for the trip, but now his 2-ton Federal makes the trip in two days. Recently he has been hauling baskets of apples and other fruit over this route, the roads of which are worn out from travel.

John P. Farrell has been making hauls from New Britain, Conn., to various towns in New Jersey, hauls of 150 miles and over. His Federal has been making the trip in 10 hours and has taken the place of eight horses.

Sweeney Bros., of New York, make trips to Newport, R. I., Boston, Albany and other towns in that vicinity. Their most frequent trips, however, are made to Philadelphia. Seven of these trips were made during the severe snowstorms recently experienced. Mr. Sweeney reports that "Our 2-ton Federal has made these regular trips to Philadelphia, averaging 10 miles to a gallon of gasoline, and we never have had an accident nor been delayed for ony other reason."

The American Enamel Company, of Providence, R. I., have had troubles of their own. L. M. Gamwell, factory manager, says: "The situation in hauling with us was we were being embargoed almost all of the time getting our lumber cars shipped, and after getting the embargo released for a given period we realized that we absolutely could not take advantage of the time given us by the railroad to load out cars if we depended entirely upon our horse teams."

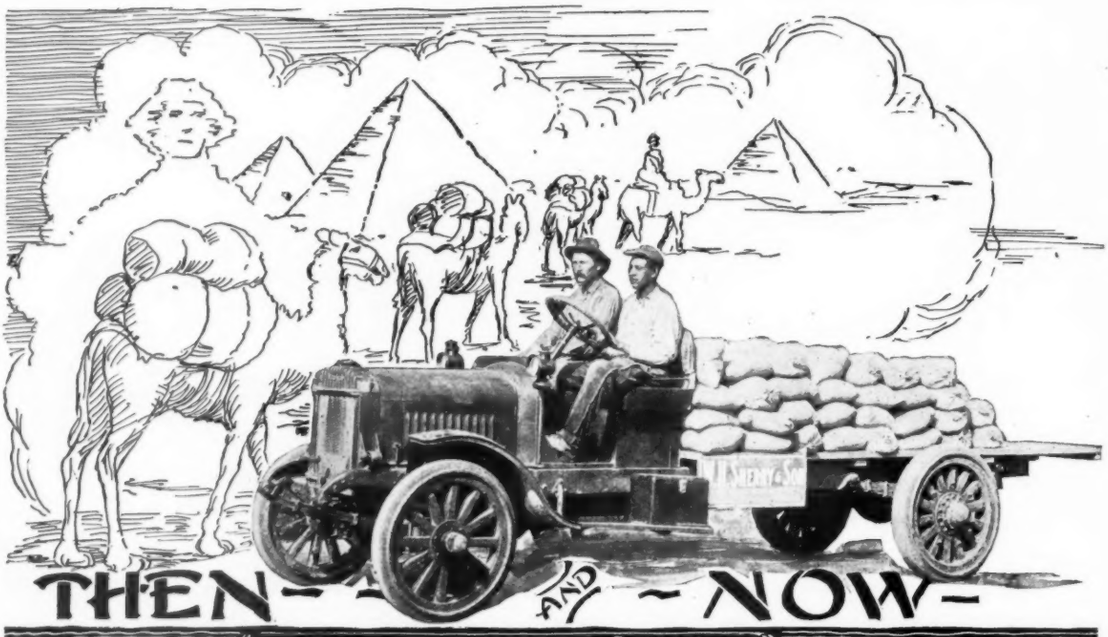
Consequently they purchased trucks to be used in their lumber mills in Maine and in their factories at Providence. The work these Federals have been doing over the worst kind of roads and in all sorts of weather would make a very long story. Their trucks have relieved the situation and have entirely eliminated delays and embargoes which have so upset their plans.

Truck Copes Successfully with Snowstorm

A 2½-ton U. S. truck in the service of the Dayton Transfer Company, Dayton, Ohio, went from Dayton to King's Mills and back, a distance of 66 miles, during one of the heaviest snowstorms of the winter 1916-17. The snow was so deep that the radiator pushed a pile of it ahead of the truck for the entire distance. This made it necessary to make the entire trip on low gear, but the radiator was always cool. Twenty gallons of gasoline were consumed on the trip.

ACASON 3½-TON TRUCK AS OPERATED IN HAULING CONSTRUCTION MATERIALS BY PETER'S CARTAGE CO. ON INTERURBAN TRIPS.

MASTER TRUCKS



"In spite of deep mud or snow (on 12½% grades) our Master 2-ton truck carries sixty-two hundred pound loads as readily as though it were running on level ground.

"A 2-ton truck which has the power and stamina to wade through rotten roads under a 3-ton load is certainly "Master of the load on *any* road"—our **Master** 2-ton truck does it without effort and the springs never whimper.

"Our **Master** 2-ton truck does as much work as any 3-ton truck we know of and on a smaller gasoline consumption."

MASTER TRUCKS

Are made by a Dependable company who make nothing but **Master** Trucks—and each and every one is built like a steel Pullman for sturdiness and safety.

The famous **Master** 2-ton truck, light, strong and powerful, with its special **Master** H U Buda Military Motor, sells for only $2190—**Master** 3½-ton, $3590 (worm)—$3390 (internal gear)—**Master** Tractor, $2450.

Write for full information concerning the exclusive **Master** Hydraulic Hoist and Dump Body, and the special body designs for every purpose. Few open territories for good salesmen.

MASTER TRUCKS, Inc.

3145 S. Wabash. CHICAGO, U.S.A.

DESIGNED BY MASTERS---BUILT BY MASTERS

U. S. TRUCK WITH FLOATING POWER PLANT EASILY NEGOTIATES ROUGH GROUND IN INTERCITY HAULAGE.

Duplex Truck Used in Overland Delivery of Freight

When the new factory buildings of the Duplex Truck Company, in Lansing, Mich., were ready for occupancy, all machinery and materials were moved from the Charlotte plant overland by motor trucks, a distance of 19 miles. Practically 1,000 tons of machinery, steel and other materials were transported by Duplex trucks—the average load being 4½ tons, and the trips totaling 224.

To have moved the machinery and materials by railroad, 40 freight cars would have been required, and the freight charges would have totaled $1,060, or $26.50 per car of 25 tons capacity. It would also have been necessary to handle the machinery and materials four times. The motor trucks, however, were loaded inside the Charlotte plant and unloaded inside the Lansing factory, the machinery being left where it was to be placed and the materials where they were to be stored. The saving in transferring at both ends, by the use of trucks was considerable. The total cost of transporting the 1,000 tons by motor truck was $560. Each truck made four trips per day and hauled a total of 18 tons daily. The operating costs of each truck including driver's wage and depreciation was $10 per day.

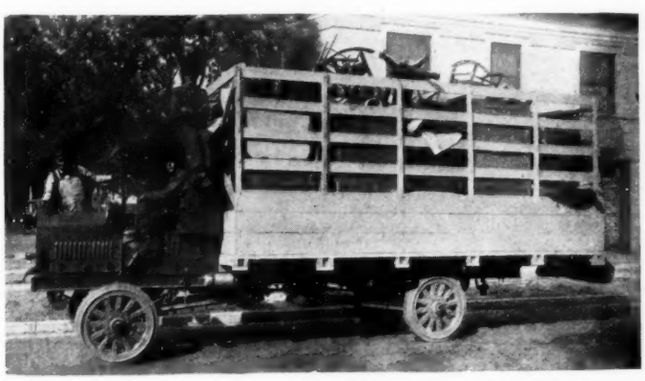
"We saved $500 in transportation charges alone," said President H. M. Lee, "by utilizing our motor trucks instead of freight cars. Then, too, the fact that it was necessary to handle the heavy machinery and materials but twice, instead of four times, as would have been the case had we used freight cars, resulted in a big saving—how much we have not estimated, but it undoubtedly would total several hundred dollars. We completed our moving in shorter time than it could have been accomplished by the railroad. In fact, I dont' believe that we would have been able to secure the 40 freight cars, that would have been required, for several weeks and perhaps months. Two trucks could have moved the 1,000 tons in 28 days, but we used three and four trucks on some days and thus got our machinery into our new plant, and in place for operation, only a few hours after it left our Charlotte factory.

"The practicability of the motor truck for short hauls was clearly demonstrated, as well as the fact that motor truck transportation costs are about one-half as much as the tariff charged by railroads."

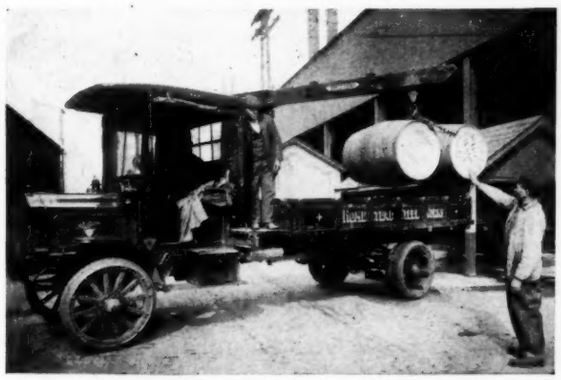
Packard Trucks on Long Hauls

Another splendid example illustrating the capabilities of the motor truck was the trip made by a Packard truck from Detroit to the Mexican border and return last spring. This truck was bought by the United States Tire Company at Detroit and equipped with pneumatic tires. The round-trip distance was 4,288 miles. On the way down to the border this 1½-ton vehicle carried a load of 2¾ tons. For 15 days it rained and the truck had to buck one stretch of 100 miles of mud from 12 to 18 in. deep. On the return journey the truck carried a capacity load of 3,000 lbs. The average mileage per gallon for the entire trip was more than 7 miles per gallon. The highest average was 11.7 miles per gallon on a stretch of excellent highway in Kentucky.

W. G. Fiske, of Upton, Mass., got an order for lumber from New York, 225 miles away, on condition that he could put it on the dock in New York in 24 hours. A traffic tie-up eliminated railroad shipment. Mr. Fiske put the 11,500 lbs. of lumber on the back of a stout Packard truck and had it on the dock in New York 22 hours later. The return journey was made in 20 hours. The roads ranged from bad to excellent.



DUPLEX TRUCK AS OPERATED BY CITY TRANSFER TRUCK CO., OKLAHOMA CITY, IN INTERCITY HAULAGE OF FURNITURE.



PACKARD 3-TON TRUCK AS OPERATED BY HOMESTEAD STEEL WORKS, HOMESTEAD, PA., IN INTERCITY HAULAGE.

"From Staten Island, N. Y., to South Framingham, Mass., in 24 hours with a five-ton load and back again.

"With a Stamford (Conn.) load, our 3½-ton DIAMOND T made this 498-mile run over all sorts of roads (including stops at hotels) in 3½ days.

"After a one-half day's rest, the same men reloaded and started for Boston, Mass., with a 4½-ton load, delivered the load in good order, made the trip of 526 miles in just four days, including stops at hotels, and a wait of seven hours in Boston.

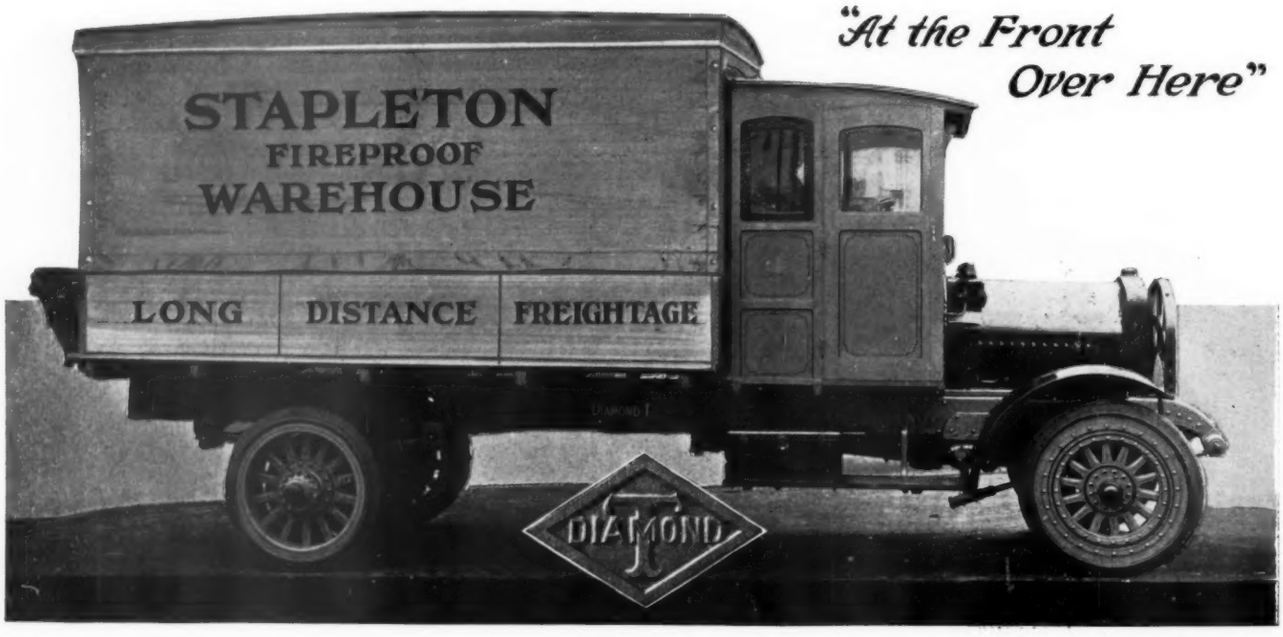
"On this entire run of 1024 miles they used the total of 7⅓ gals. of oil and 117 gals. of gas, and did not loosen a bolt. We might add that this truck has traveled in all 8500 miles, has never been laid up or overhauled in any way; in fact, we do not know what trouble means."

Stapleton Fireproof Warehouse, Stapleton, N. Y.

DIAMOND T Motor Trucks (1, 1½, 2, 3½, 5-ton capacities) are powerfully strong and *over-size* all the way through. Their stronger-than-necessary construction *protects* you against mishap—they *"stand up"* under cruel and gruelling abuse! Big, Sturdy and Dependable, yet Light-footed in picking their way over bumpy roads, grade crossings and cobblestones. Our illustrated literature will interest you.

Diamond T Motor Car Company

Factory and General Office, 4505 West 26th St. CHICAGO, ILL., U.S.A.



The Liggett Company, operating the largest chain of drug stores in America, finds that its Packard trucks are saving so much in lessening distributing expense that they pay for themselves and all contingent equipment within one year. Each of the 170 stores, extending to Boston on the north, Detroit on the west and Philadelphia on the south, receives a weekly shipment from headquarters in New York. A 5-ton truck and a trailer of the same capacity supplies the Philadelphia stores. The round trip of 225 miles is made in two days. Two handlings, two days' time, a considerable money saving and a big reduction in breakage loss are economies from the use of the truck. Similar long-distance trips also are made to cities in New Jersey and Connecticut.

S. Inlander & Co., of Chicago, are using Packard trucks for deliveries to customers 30 miles and more out in the country. It takes a week to send a shipment of paper that far by freight. The truck does it in two hours.

(Continued in April Issue)

Dump Truck Powered with Wisconsin Motors

CONSISTENT

The standard power for municipal trucks

Write for specifications on different types and sizes.

WISCONSIN MOTOR MFG. CO.

Station A. Dept. 330
MILWAUKEE, WIS.

New York Branch,
21 Park Row,
T. M. FENNER, Factory Rep.

THE TEN-YEAR TEST

Has Proven the Efficiency of the Duplex 4-Wheel Drive Principle

There is nothing new about the principle of making ***every wheel a driver!*** Duplex originated it ten years ago.

Only the first model was experimental. And it was this model which shattered all existing records for hauling, hill climbing, and exacting road-ability under the severest conditions.

Today, the Duplex Truck is a product of ***experience.***

Write for our catalog and the heavy hauler's magazine, "Duplex Doings," issued in the interest of better transportation methods.

Address all communications to Dept. 112.

Duplex Truck Company, LANSING, MICHIGAN

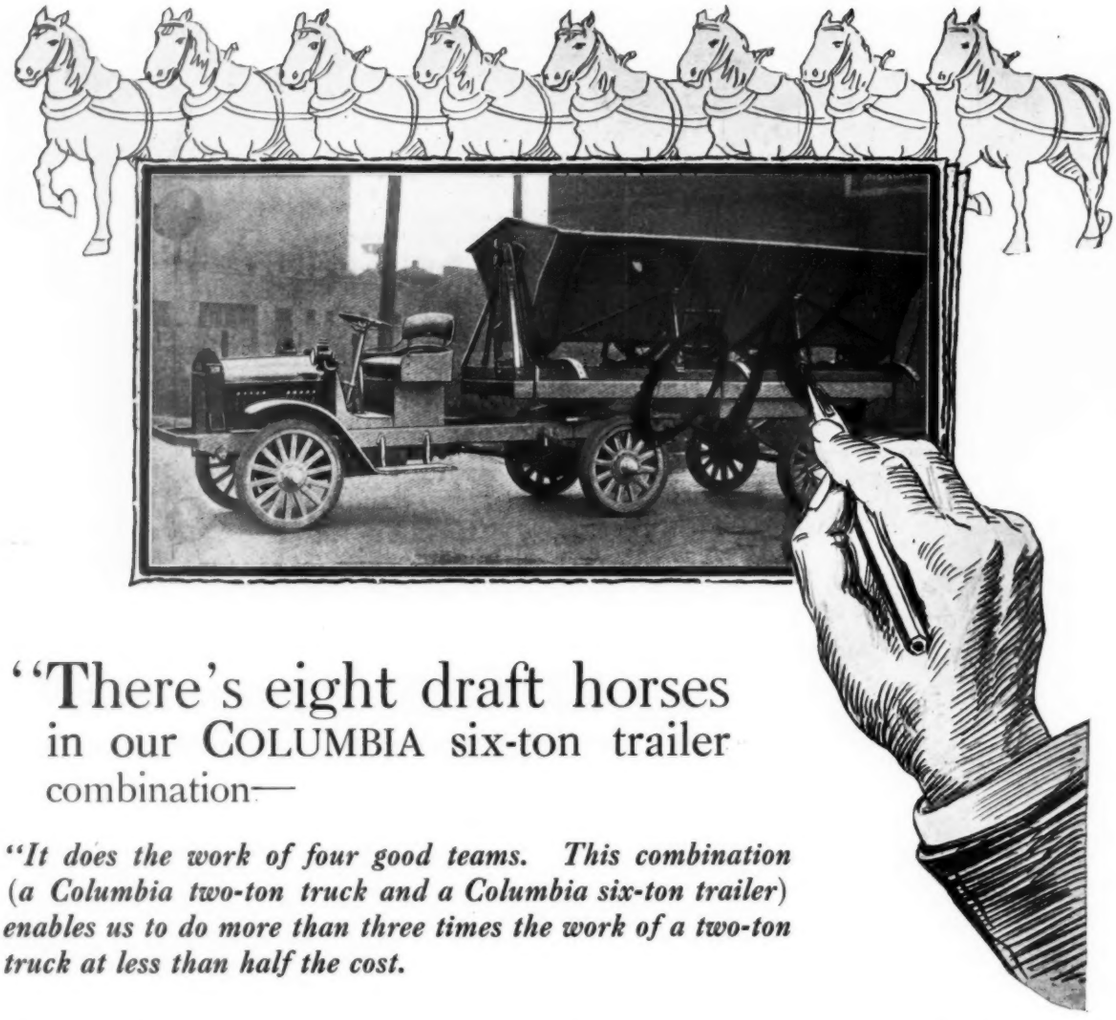
A Real "Movie" For Shovelers and Trucks

The load is ***always ready*** when the truck rolls up! Shovelers ***always*** shoveling!! Trucks ***always*** trucking! No "loafing" or "stalling" or "war discussions"! That's why you get more work done with fewer trucks and fewer shovelers.

"Heltzel 'Lightning' Loader Skips double the work of our trucks—load them with crushed rock, sand, coal, gravel or ballast at the rate of ***a truck per minute.***" **"Heltzel Loader Skips** enable us to overcome man-power shortage and side-step demurrage charges as well. They keep everyone moving. We are doing more with less men and fewer trucks and at a saving of $6.00 per car."

Heltzel Steel Form & Iron Co.

WARREN, OHIO.



"There's eight draft horses in our COLUMBIA six-ton trailer combination—

"It does the work of four good teams. This combination (a Columbia two-ton truck and a Columbia six-ton trailer) enables us to do more than three times the work of a two-ton truck at less than half the cost.

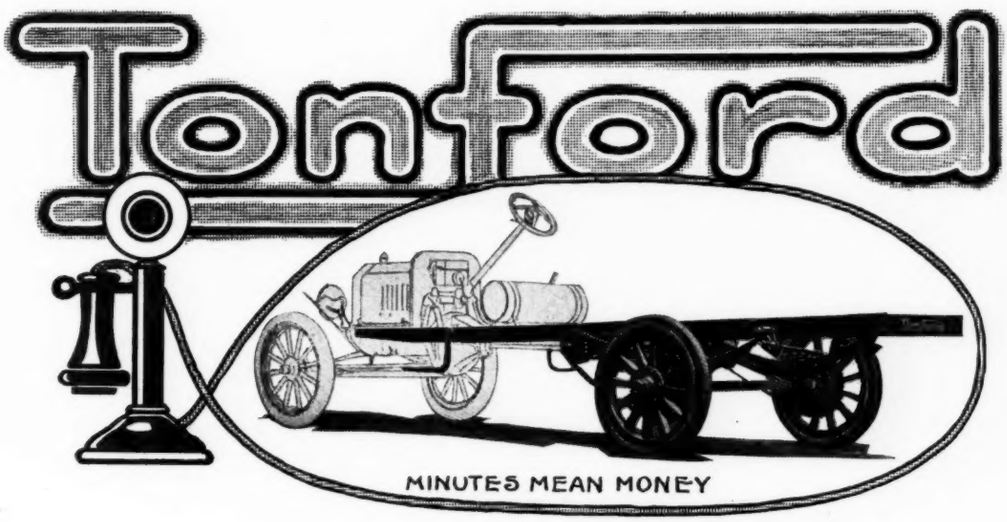
"In addition to increased hauling capacity, the COLUMBIA Combination provides greater flexibility in the transportation and increase the truck's actual operating hours. There is no time lost in loading and unloading. One of the trailers is always traveling with the tractor-truck while the other is being loaded or unloaded."

The COLUMBIA two-ton Truck ($1990) is oversize in every part. In spite of its low price, it is the sturdiest and most dependable two-ton truck on the market. Continental "Red Seal" 40 h. p. Motor, Pierce Governor, Schuler Front Axles, Russel Internal Gear Rear Axle, Hayes Special Truck Wheels, Eisemann Magneto, Timken Roller Bearings, Covert Transmission.

We make a Full Line of Trailers (for every purpose) in capacities from one to ten tons. The six-ton trailer is priced at $760. The six-ton combination (including COLUMBIA two-ton tractor-truck) is priced at $2750. COLUMBIA trailer and semi-trailer units will be shipped with your COLUMBIA Trucks or tractor-trucks. No delays.

Columbia Trucks and Trailers are guaranteed for one year from date of purchase. Immediate deliveries.

Columbia Motor Truck & Trailer Co.
PONTIAC MICH.



The Steel Built Tonford has all the weight it needs for strength plus—but it's the lightest truck for its capacity in the world.

"Each of our *Tonfords* regularly do three times the work of a team—and they do it decidedly cheaper.

"Minutes mean money in the contracting business, and our ***Tonfords*** keep all crews working on the jump. They operate at ***100 per cent efficiency*** all the time.

"Light in weight, but enormously strong and easily handled, they are ***just right*** for medium sized jobs. They both go on the big job.

"*Tonfords* get around the corners, ***into the corners,*** into high and out-of-the-way places where teams and larger trucks would not venture.

"*Tonfords* are willing workers and money makers for the contractor. They ***stand the racket*** and are as dependable as sunrise."

The *Tonford* Split Flange Sprocket gives a 56-inch tread on rear without large rear wheel sprockets and the consequential injury from both chains and sprockets.

Owing to the tremendous increased demand for ***Tonford*** units, we have more than ***doubled the capacity*** of our plant. Internal gear, $390; chain drive, $350; f. o. b. Detroit.

Few Territories Open for Good Salesmen

IMMEDIATE DELIVERIES

Detroit Truck Company

8th & Fort Street. DETROIT. MICH.

The Seal of Dependable Performance

ACME THE TRUCK OF PROVED UNITS

Trade Mark Reg. U. S. Pat. Off.

HAULING COSTS BELOW YOUR ESTIMATES

Acme trucks are your friends in keeping hauling costs down to estimates. For in the varied field of municipal haulage, the powerful **Acme** performs dependably. Comparative figures which we will furnish show the **Acme's** advantages. Users report astonishing economies. Special quick-unloading features save time and money.

ACME

Proved Units a Service Bond

Acme proved units are the acknowledged leaders, known to yield far greater, far more dependable service, at much lower cost per mile.

Timken Axles, Timken Bearings, Timken Worm Drive, Continental Motor, Detroit Springs, Cotta Transmission, Pierce Governor, Ross Steering Gear, Long Radiator, Pressed Steel Frame—and so on. Each unit a master contribution to a master truck.

Write for a copy of *"A Pointer to Profits."*

Acme Motor Truck Company

221 Mitchell Street **CADILLAC, MICH.**

One-ton to Four-ton Models—Each oversized in both capacity and dimensions.

Solving The Haulage Problem

CLEVELAND telephoned Cincinnati for supplies—A big contract depended upon quick shipments.

There wasn't a freight car to be had for love or money.

But that did not bother Cincinnati. The telephone message came at eight-thirty in the morning.

At ten-thirty a big three-ton truck was on its way north loaded to capacity—

Shortly after noon the next day it was unloading at its Cleveland destination.

The saving in time alone was worth more than the entire cost of the truck.

Under existing conditions the motor truck is an economic necessity.

The railroads *must* be relieved—commerce and industry *must* depend upon the motor truck for short hauls, and frequently even for comparatively long hauls.

Wilson transportation engineers will help you to adapt Wilson Trucks to your haulage requirements.

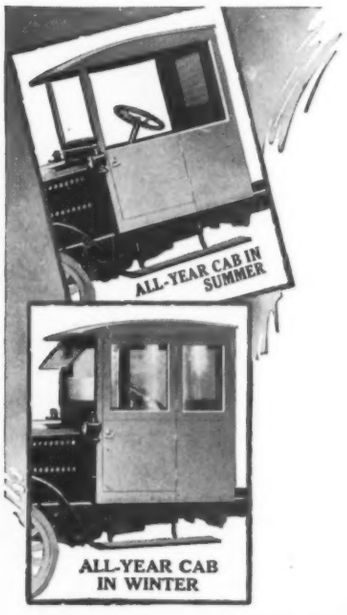
Wilson Trucks are the product of more than thirty-five years' experience in the building of heavy duty transportation vehicles. One-, two-, three- and one-half, and five-ton worm drive models.

We will be glad to hear from a few more dependable dealers

J. C. WILSON COMPANY, Detroit

Contractors—Here's Rain. Wind and Snow Protection for Your Truck Drivers!

The past winter has proven the acid test for the ALL-YEAR Cab in the contracting business. By fully protecting their drivers, contractors have been able to maintain uninterrupted excavating schedules, increasing their financial results.



As this winter, so this spring, the ALL-YEAR Cab will afford your drivers full protection from March winds and spring rains, increasing their efficiency and eliminating unnecessary lay-ups of your trucks.

In summer the ALL-YEAR Cab is quickly changed to a cool, open housing by removing the winter attachments, consisting of side, door and rear windows.

KISSEL TRUCKS

There are five new sizes—a truck for every sized excavating job. The Kissel built-in strength in frame, axles, springs, brakes and other structural parts—the Kissel-built power plant equal to all power demands, insure dependable performance and reliable service necessary in the contracting business.

Investigate the new Kissel Trucks and the ALL-YEAR Cab. Send for literature and specifications, or see your nearest Kissel dealer.

KISSEL MOTOR CAR COMPANY, Hartford, Wis., U.S.A.

Tons! Eighty to one hundred and eighty per day! For months and practically no repairs! *That's economy!* "Our 5-ton HALL has been in constant use for months. Hauling from eighty to one-hundred-and-eighty tons an average of fifty miles each working day at a fuel cost of one gallon every six to eight miles. Our expense for repairs, aside from tires, has been practically nothing." No ordinary truck could retain its efficiency and still stand the abuse that HALL Truck is receiving. That's why we say that HALL Stamina means *Low Cost of Up-keep.* Big, Sturdy, Dependable HALLS are built to stand the grind and hold down the up-keep—and they do! One HALL Truck "on the job" is worth any number in the garage!

"Haul it in a HALL."

THE LEWIS-HALL IRON WORKS

Manufacturers of the HALL Truck

(Established 1873)

Ferry Avenue and Grand Trunk Ry. **DETROIT, MICH.**

Eastern Distributor: R. D. King Motors Company,
9 Central Park West, New York City.

The 5—6-ton TITAN Climbing

a 20 to 25% grade—500 ft. long—with 7 tons, in 2 minutes

(Guaranteed a Regular Factory Test)

Built *especially* for *contractors* by men of seven years of manufacturing experience in heavy duty trucks and by men of over twelve years of manufacturing experience in contractors' machinery.

It will deliver *30 to 50 per cent more power to the rear wheels than a* worm drive when starting up and on low gear *—that's why the* ***Titan*** will do more than ordinary trucks in pulling your loads *out of gravel pits* and excavations.

It handles 6½ tons on truck with 5-ton trailer (11½ tons) up an eight per cent grade on second gear.

Our literature tells why "the ***Titan*** *is a* ***real*** *Contractor's truck."*

TITAN TRUCK CO.

25th and St. Paul Avenue MILWAUKEE, WIS.

HURLBURT

6 CYLINDER - - WORM DRIVEN

"HURLBURT Trucks are *delivering* our freight *on schedule* to New York and New Jersey points. Roads have not been in condition for heavy hauling, yet 'no less than truck-load' shipments (5 tons) are made.

"We are getting our loads from point to point at a ***moderate*** cost, and we're sure it is ***going to arrive.*** **Hurlburt** Trucks operate on an exceedingly low gasoline consumption.

"We have experienced ***no trouble*** of any kind and have had ***no breakdowns*** due to hammering of badly balanced loads over rough roads."

Any owner who has tested the HURLBURT Truck—who is able to compare trucks all along the line as to tire replacements, service rendered in relation to upkeep and depreciation—will tell you that the HURLBURT Truck is the *best built truck in America.*

If you want ***immediate*** deliveries, order a **Hurlburt.**
Few open territories for live dealers and salesmen.

Hurlburt Motor Truck Company

Third Ave. and Harlem River. **NEW YORK CITY.**

"MAN Power is scarce and we are speeding-up with SIGNALS. Our two SIGNAL Trucks, rated at 2½ and 4 tons, are showing every day nearly the same ton-mile per hour capacity as average 5- and 6-ton trucks."

Special metals and *competent* engineering make the SIGNAL Truck not only the strongest but the lightest truck of its rated capacity. That means ***minimum cost*** for tire maintenance and depreciation—***maximum life—more work.***

SIGNAL Light Service Trucks for speed; SIGNAL Heavy Service Units for big loads. Both for ***economy!*** There is a size for every haulage requirement, and reasonable deliveries are promised.

The boys are going! Not from your city alone, but from thousands of towns and cities throughout the U.S.A. Railroads are congested! Freight must be moved and construction work must be put through. Supplement man-power with SIGNAL power.

"Signal Trucks "Stand Up."

SIGNAL

Signal Motor Truck Company, Detroit, U.S.A.

All sizes (1¼, 1½ to 1¾, 2½, 4 and 5 tons) and all Worm Drive! Continental Motors, Timken-Detroit Axles, Brown-Lipe Transmissions, etc.

EDITORIALS

Speed Up National Road Plans

The policy of the federal government is favorable to the construction of essential military and market highways this year, but the plan, the all-important **plan,** has not been formulated. Thus it may be said that with respect to the building of these roads the government has good intentions. Good intentions are necessary, but not sufficient.

A spur to action comes with the thought that the federal government has favored other measures which it was long in making effective. Though indorsing military preparedness, our federal officials allowed this nation to drift stern foremost into the war; though attempting to arm our troops, there was, and still is, deadly delay in selection and production; though favoring merchant ship construction, choice of type and haggling over details were permitted to delay the shipbuilding program, so that now, almost a year after we went to war, we are **nearly** ready to utilize the services of volunteer ship builders.

Since war was declared there has been a lack of coordination of effort. Investigations and immature plans have overlapped, become entangled, retarded progress. In numerous instances too many different departments, bureaus, boards, councils, committees, etc., have taken up the same problems and have expended their great energies and precious months in attempting to agree on working plans. The same tendency will endanger the road program unless an informed public opinion demands the speedy formulation and execution of a working **plan.**

The **policy** of the federal government, as it relates to highway construction, is rational. In line with a request made by Secretary McAdoo, Secretary Houston, of the Department of Agriculture, which includes the office of public roads, has determined that so far as is practicable the federal aid funds shall be applied during the working season of 1918 only to the construction of such roads as are vitally necessary to improve the transportation system of the country, or to make feasible an increased output of important agricultural products. No fault is found in this general statement of policy.

Now, how is it proposed to apply this policy through a working plan? The first step was the issuing of an order by the Director of the Office of Public Roads and Rural Engineering to district engineers that they take up with the state highway departments in their districts the question of formulating a program for the expenditure of all such funds as are available for the working season of 1918 and such additional period as may be required. It was stipulated that all projects, whether approved or pending, and any additional projects desired by the state, should be included. State highway departments were requested to conform as nearly as possible to the announced federal policy. A supply of schedule forms indicating the information desired was furnished for the use of the highway departments in preparing their program. The Director stated that this information should be had **at the earliest possible moment.**

That order was issued on January 11. On February 6, almost a month later, the Director stated that "up to this time only a very few of the states have submitted their schedules." The state highway departments cannot escape criticism for this delay. The Director said moment, not month! If even the newest of the state highway departments cannot pass on this matter in a month, what sort of delay shall we expect when the state reports reach Washington and the problem of connecting highways for interstate traffic is taken up? The state departments should be galvanized into greater activity. It is true that the schedules sent out from Washington call for a description of each road, the character, quantity and rail haul of the materials to be used, the probable cost, the amount of federal funds desired, the specific purpose of the improvement and its bearing upon the war situation. If taken too literally that is indeed a large and formidable order, but this is no time for cheese paring and hair splitting in making cost and other estimates. A great emergency is upon us. We haven't all summer to figure on these roads; we must **build** them! The reports, complete as to broad essentials and as complete as to details as practicable, should be returned to Washington now.

When the state reports are returned to the Office of Public Roads they should be connected up and correlated in the briefest possible time and a comprehensive national highway construction plan formulated. This should be left to the Office of Public Roads, and all other government agencies should keep their hands off the planning. This includes Congress, with its Chamthe actual planning. This includes Congress, with its Chamberlain comprehensive military highways bill, which directs the Chief Engineer of the Department of War to prepare the plans. Since the Department of Agriculture is working on the plans, to have the Department of War take up the same problem would merely make for delay.

When the plans are completed, which should be by April 1 at the latest, the next move must come from Mr. McAdoo, Secretary of the Treasury and Director General of Railroads. In the first capacity he should see that federal aid funds are released for use on the construction of designated highways and that the Federal Reserve Banks shall specify highway construction as a war essential, thus lifting the ban that has rested on the sale of road bonds. This will enable state and county authorities to raise funds to match the federal funds dollar for dollar, and also to construct other highways held essential, though not granted federal aid. In his capacity as Director General of Railroads he must see to it that priority orders and embargoes do not prohibit the transportation by rail of road-making materials and machinery. This will put the actual construction up to local authorities, who can be depended upon to push it.

The delay of the states in reporting back their road plans to Washington is regrettable, but not fatal. A prolonged delay in Washington in considering these plans, and in removing restraints to their execution, will be fatal, absolutely so, to the construction of essential military and market roads this year. Such a delay the public must not tolerate.

City Engineer, Superintendent of Water Works and Sewers

Under the eye-arresting caption, "How a Deficit of $2,000 Was Changed to a Surplus of $27,000 in One Year at the Waltham Water Works," an article is published in this issue that merits the most careful reading. The article was written by a man whose official title is: City Engineer, Superintendent of Water Works and Sewers. That there is a direct connection between the fact expressed in the caption of the article and the duties of the author, as expressed by his title, we are firmly convinced. His engineering training and experience, coupled with his intimate and expert knowledge of the city engineering department and the local sewerage system, enabled him to take hold of the management of the local water works and in one short year convert an annual deficit of $2,000 into a surplus of $27,000. Just how this result was accomplished by the introduction of business-like methods, most of which are of universal application, is related.

In the average city of ten thousand inhabitants and over there is a city engineer, a superintendent of water works and a superintendent of sewers. The superintendent of sewers is also in many cases superintendent of streets, though there are many cities where there is a superintendent of streets to complete the squaring of the local engineering circle. This arrangement reminds us of nothing so much as the familiar sight of four churches, of different denominations, at the four corners of the public square. In each of these churches the Word is expounded by an estimable gentleman who, as a preacher, is of the fourth class or lower. What a melancholy thing it is that the four congregations do not unite under one roof, and, by pooling their finances, provide enough in the form of a salary to attract and hold a first-class preacher! This would not only strengthen the remaining church, but would, as an auxiliary benefit, release the other three preachers to the immediately productive task of plowing corn.

Exact parallels are seldom encountered except on the mathematical reservation, but the parallel here indicated is close if not exact. The consolidation of the four local engineering functions under a single competent and well-paid head is quite as desirable as the ecclesiastical consolidation suggested and is free from the sentimental and transcendental objections which adhere to the latter.

The greatest work remaining in the water works field is the general introduction of efficient and economical operating methods—to no better task can the great water works associations address themselves. If these associations would advocate and work, through suitable standing committees and appropriate publicity methods, for the consolidation of the city engineering and water works departments under the management of an engineer, this desirable end would soon be realized in very many localities, and the bringing under the same head of the sewer and street departments would naturally follow. That there are many competent water superintendents now is not denied; these men have nothing to fear from the new alignment suggested, as they are in charge of departments requiring a competent head, whether they be directly responsible to a board of water commissioners, a city council, or to the head of the city's engineering bureau. On the other hand there are many superintendents who could be removed in the consolidation process without permanent or substantial loss to themselves and to the great advantage of their cities.

Workers for the Shipyards

The war will be won or lost in the American shipyards. At this time the paramount need of America and our allies is for workers in these shipyards; it is vital and urgent. Edward N. Hurley, chairman of the United States Shipping Board and president of the Emergency Fleet Corporation, is calling for 250,000 men, skilled mechanics and laborers, to volunteer their services to help the men now engaged in building merchant shipping. It is urged that men who desire so to volunteer go at once to the nearest enrollment agent of the United States Public Service Reserve of the Labor Department, or to the local enrollment agent of his State Council of Defense, and register themselves as willing to work in the shipyards if needed; then to retain their present positions until called individually.

How imperative is the need for men may be concluded by any person who will but reflect that last year Great Britain produced only 1,163,474 tons of shipping, and the United States but 901,223 tons, making a total new tonnage of 2,064,697, while sinkings by submarines during the same period are estimated at 6,000,000 tons. That way lies disaster. Men must come forward to man the great American yards now nearing completion; engineers and contractors must use their influence to that end. Contractors should note that laborers of all classes are wanted—men whose places can be taken by labor-saving machinery on construction, and should urge them to volunteer.

Original Matter

The discriminating reader undoubtedly has noticed the heavy preponderance of original matter in the reading pages of this magazine. About 90 per cent. of all articles published in MUNICIPAL ENGINEERING during the past six months were written for our exclusive use. The remaining portion of the editorial matter has been made up of articles of varied origin which we have felt should be published in our readers' interest, though not written primarily for that purpose. It is doubtful if any engineering periodical has exceeded, if indeed it has equaled, this sustained record of freshness and originality in reading matter.

The significance of this record should be noted. The reader will not find in the pages of MUNICIPAL ENGINEERING a plethora of papers prepared for presentation before professional societies. The scheme of monthly publication lends itself readily to the exclusion of matter which the journal of more frequent publication commonly uses in its craving for copy. Neither will our readers find windy dissertations on matters of but momentary interest to a minority. Underdone abstracts of voluminous city reports are also taboo. In general, the editor hopes to enjoy the esteem of his readers for what is omitted quite as much as for what is admitted.

In each issue experts exchange ideas with each other and with members of the profession generally. Thus, in the December issue announcement was made of special contributions promised for 1918. These articles are all by recognized authorities and are a leading feature of current issues. The January issue, for example, contained articles by Messrs. Howard, Brossmann, Thomas, Pearse, Ledoux and McDonnell. The February issue contained the special contributions of Messrs. Knowles, Alvord, Weston, Collins, Tribus and Shields.

There are more of these special articles in the March issue, as well as many other articles of equal merit, and there will be others in every issue.

SEWER DESIGN AND CONSTRUCTION

Simple and Inexpensive Method of Lifting Sewage Sludge to Sludge Beds or Outfall Sewer

By Alexander Potter, Consulting Engineer, 50 Church Street, New York, N. Y.

It is often impossible to construct a sewage settling tank at such an elevation above the ground that the head of the liquid in the tank itself is sufficient to force the sludge on to the sludge drying beds by gravity.

Where the sludge can not be discharged upon the sludge drying beds by gravity, pumping, of course, must be resorted to, and especially in smaller installations it is very difficult to secure satisfactory results, because either the pump loses its priming or some foreign substance clogs the lower end of the suction pipe, or perhaps in most cases a combination of both these troubles occurs, which makes pumping unsatisfactory in many cases.

Vacuum Pump and Receptacle

To overcome the difficulty thus encountered in some forms of settling basins, both deep and shallow, the writer devised a simple method of lifting the sludge above the surface of the water in the settling tank into a receptacle from which it could flow by gravity on to sludge drying beds or into the outlet of the treated sewage, as the case might be.

The figure shows such an installation and an examination of it discloses that the apparatus consists of a riser pipe extending from the bottom of the sludge chamber and discharging into the top of a steel tank 4 ft. in diameter and 4 ft. deep, with a tapered bottom, erected above the surface of the sewage in the settling basin. From the tapering bottom of this tank a pipe is led either to the sludge beds or to the outlet end of the settling tanks. The steel tank thus described is gated on the inlet and outlet ends with an air tight valve. There is located in the building near the steel tank a small rotary vacuum pump direct connected with an electric motor, if electric current is available, or to a small gas or gasoline engine, if electric current is not readily procurable.

The vacuum pump used in several recent installations was a No. 2 Rotary furnished by the Beach-Russ Company of New York. This pump is of the rotary sliding vane type, thus obviating the usual resultant troubles common to the reciprocating type of valve pump. A cylindrical drum is eccentrically placed in a steel elliptical cylinder, the drum consisting of four sliding plates. As each plate passes the inlet port it takes in and traps the air, carrying it around to the point where the drum and cylinder come into contact and presses the air out at that point. There is no appreciable wear due to operation, and the pump will stand considerable abuse.

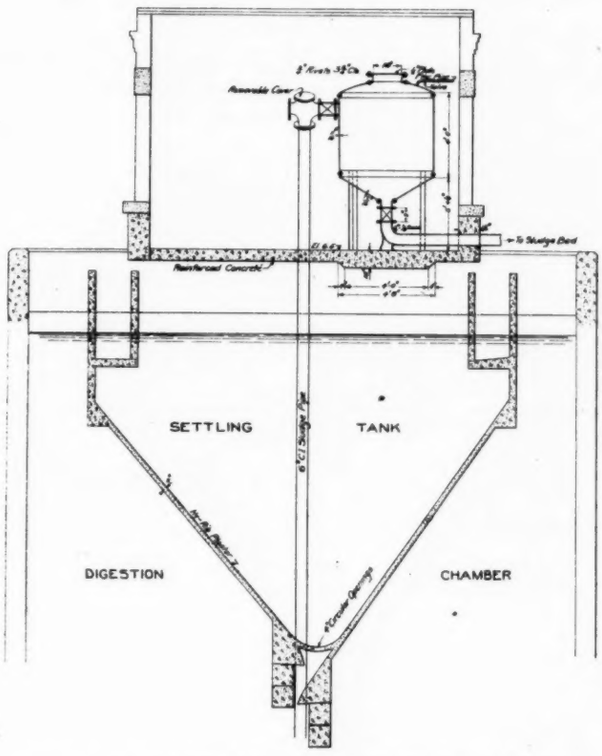
Operation of Sludge Lifting Device

To operate the sludge lifting device, the valves are closed on the inlet and outlet pipe and the air exhausted by means of the vacuum pump. A vacuum of 28 ins. is readily procurable, provided the inlet and outlet valves are tight. In this connection it might be stated that while it is easy to procure valves which are tight against 300 lbs. of water pressure, many of these valves are not air tight against much lighter pressures.

When the air has been exhausted, which will probably take ten minutes, the inlet valve is opened slowly at first and the sludge rushes up from the bottom of the sludge chamber until the air pressure within and without the tank is balanced. The outlet pipe can then be opened and the tank emptied.

Removing Obstructions

As above stated, the mouth of the pipe extending down into the sludge is often obstructed, sometimes totally, by a piece of water soaked board, a brick or some other foreign substance which normally should not enter the tank, but which causes considerable inconvenience and trouble when a centrifugal pump is being used to lift the sludge. When such a condition occurs with the apparatus herein described the simple manipulation of valves changes the vacuum pump to an air compressor and the steel tank becomes an air receiver.



SIMPLE APPARATUS FOR LIFTING SEWAGE SLUDGE FROM SETTLING TANKS.

When the inlet valve of the tank is opened the compressed air rushes down through the inlet pipe and readily dislodges any obstruction which may be blocking its mouth.

The cost of installing the pump motor and steel receiver to care for the sludge of a city up to 10,000 people is less than $1,000.

Latest Developments in Poured Joints for Vitrified Pipe Sewers

By H. P. Boynton, Engineer's Building, Cleveland, Ohio

Developments of the past few months in sewerage practice make it virtually certain that the process of troweling sewer pipe joints by hand out of Portland cement mortar will be replaced by poured joints within a comparatively brief period. The Sewer Pipe Manufacturers' association, a body organized for publicity and research in the sanitary field, has stood sponsor for experiments directed toward this outcome and its field commissioner, John L. Rice, expresses himself as satisfied with the outcome.

Disadvantages of Troweled Joint

The association takes the view that their material has suffered too long from unmerited criticism, growing out of instances where the methods of joining have been defective. Against the hand troweled joint, it is recognized that a trench is an awkward place for careful workmanship and that, where success depends upon the skill of a manual operation, there would be a considerable number of faulty joints due alone to the difficulties under which the sewer worker labors.

But the difficulty with this form of joint has at least two other sources:

1. Cement and sand mixed in a comparatively stiff consistency do not result in an impervious compound, when set, as is the case with a grout of the same composition mixed thin enough to pour.

2. Two-thirds of the trouble with hand troweled joints results from manipulating the pipe in making the ensuing joints. Even if the troweled joint is perfect, when made, it is shortly cracked by handling the other end of the pipe.

The Remedy for Poor Joints

Looking for a thorough going remedy, the association saw the comparative futility of mere emphasis on careful workmanship. The problem was to insure the penetration of the joint material into the recesses of the pipe bell and to prevent manipulation of the pipe after the material was in place and before it was set.

Obviously gravity was the most reliable force in insuring penetration. To prevent disturbance of the joint, the one requisite was to provide forms which could be applied to all of the joints of a pipe line in sequence and then permit them to be poured in sequence, leaving the form in place until the initial set is complete.

The "Flexform" Joint Form

In working out the solution along these lines, the greatest assistance was realized from De Witt H. Wyatt, a young engineer living in Columbus, Ohio, who had begun his experiments independently, but continued them in co-operation with Commissioner Rice. He invented a joint form, which he has named the Flexform, consisting of a series of overlapping, scale-like sections of sheet metal, clamped around the pipe in such a manner as to afford just room for the joint material. There is a hopper or funnel at the top through which the material is poured. The scale structure permitted a certain amount of leakage, not enough to result in serious waste, but enough to safeguard against air pockets in the lower part of the bell.

Joints Caulked with Oakum

In earlier forms of the device the sheet metal sections were strung on two steel cables of small diameter, but the newer ones are joined with hooks, so that a greater or lesser number of scales can be used in a single form, varying with the diameter of the pipe. Before applying the forms, the bell is caulked with just enough oakum to prevent the joint material from reaching the interior of the pipe.

Joint Material

For joint material the association has expressed approval both of cement grout and certain bituminous compounds of the character of G. K. compound, produced by the Atlas Company. The latter is especially recommended where rapid setting is a necessity and where, for any reason, such as trenching through filled earth, a certain amount of elasticity in the line makes a desirable safeguard against breaking strains upon the pipe line.

As the sanitary regulations of most cities direct that house drain trenches shall be left open for 24 hours after construction for purposes of official testing, the grout joint has time to set before the trench can be closed. Tests conducted under these conditions have proved uniformly that the poured grout joint is thoroughly impervious as well as economical of material, rapid and convenient of construction.

The need of removing the form is recognized, however, as a slight handicap in operations where it is desired to close the trench promptly, as in machine excavation of municipal sewers. Ensuing experiments have been directed toward developing a joint form cheap enough to be left around the joint and buried in the ground. Announcement of success in this quest is confidently anticipated.

MODERN METHOD OF POURING JOINTS IN PIPE SEWER CONSTRUCTION.

Left to Right: Applying the Form in the Trench—Pouring a Joint with Cement Grout—A Neat, Economical and Impervious Joint.

Construction Plant and Methods Employed on Recent Important Sewerage Work in Illinois

Among the most important pieces of construction work on sewerage projects carried on in Illinois during 1917 were the large intercepting sewers built by the Sanitary District of Chicago in the Calumet region and in the city of Evanston; the Argyle Street system built by the City of Chicago; the system built at the Government Cantonment at Camp Grant, near Rockford, and the Sewage Disposal Plant at the U. S. Naval Training Station at Great Lakes. The data here given on these construction jobs are from the report of the subcommittee on construction of sewerage works of the Illinois Society of Engineers, composed of H. R. Abbott, Chicago, chairman; Herbert E. Hudson, Chicago, and Edwin Main, Rockford. We are indebted to Mr. Abbott for the views shown .

Notable Construction Work by the Sanitary District of Chicago

Some interesting construction features may be briefly noted relative to the Sanitary District work. These sewers range in size from 10 to 17½ ft., horseshoe shape, and are built of concrete. In some localities they traverse soft yielding ground,

in which case the section is reinforced. The drag line excavating machine is being successfully used on several miles of the Calumet work, which passes, in some cases, through built up streets. This machine is used in conjunction with a steam shovel. The shovel is placed in the cut and takes out approximately the upper half of the total depth. The drag line follows and is also down in the shovel cut and takes out the lower half, cutting the sides of the trench vertical, or nearly so, for this portion. On one contract both of these machines deposit the excavated material direct into standard gage 10-yd. dump cars standing on track parallel with the work. This work is in good hard clay and no difficulty is experienced in holding the sides of the trench with a limited amount of sheeting and bracing. The total depths of these cuts run from 26 to 30 ft. The top portion, or shovel work, is sloped back at about one to one slope.

Three contracts on this project are now under way, the contractors being Nash Brothers, Byrne Brothers Dredging and Engineering Company and the T. J. Forschner Contracting Company. The method of excavation is similar with all. Two sections are completed, the entire length of the interceptor being about nine miles, extending from South Chicago to Blue Island and discharging into the Calumet Sag Canal.

Open Cut Abandoned for Tunneling in Soft Ground

Probably the most difficult work during the year by the Sanitary District was the construction of a 10-ft. sewer in West Lake Street, Evanston. The soft, yielding clay could not be held in place by the combined use of 3-in. sheeting, 20 ft. long, driven tight, and 30-ft. piles on 5-ft. centers. Both sheeting and piles were driven ahead of the steam shovel, which was mounted on timbers spanning the trench. This shovel later excavated between the sheeting and as the material was taken out and before the cross bracing could be placed, the movement of the clay would occur, pushing the piles and sheeting inward for the lower half of the 20-ft. cut to such an extent that large portions of the piles and sheeting had to be cut out and additional excavation made. Several schemes were tried out—using two steam shovels working tandem and using one shovel on the top lift and orange peel derrick on the lower lift. None was successful and the method of work was then changed to tunnel, where fair progress is being made, although continuous timbering is necessary. No air pressure is being used. Previously, on the same contract, some 8,000 ft. of sewers of 6, 7½ and 10-ft. sizes were built, using air pressure.

Combining Open Cut and Tunnel

Another interesting piece of work on this contract was the building of a 4½-ft. concrete sewer partly beneath and projecting into a 5-ft. brick sewer, the new sewer having a grade in the opposite direction. This work was 4,000 ft. in length and was built partly in tunnel, tearing out the lower half of the brick sewer in stretches of about 50 ft. and underpinning the arch, then building the new sewer by the usual tunnel method. After the completion a void existed between the crowns of a new and old sewer. Holes about 18 ins. in diameter were dug from the street surface, the crown of the old sewer broken through, permitting the spout of the mixer to be lowered and the void filled with grout. These holes were spaced about 50 ft. apart. On the stretch built by the open cut method the old brick sewer was ripped out by the steam shovel as the work progressed. The Evanston contract is being executed by the Nash-Dowdle Company of Chicago and comprises a complete intercepting system 9 miles in length, including all sizes from 9 ins. to 10 ft. All sewage will be discharged into the North Shore Channel of the Sanitary District of Chicago.

CONSTRUCTION VIEWS ON TUNNEL AND OPEN CUT SECTIONS OF 10-FT. SEWER IN LAKE ST., EVANSTON, ILL.

Left to Right: Blaw Steel Forms in Tunnel Section—Segmental Timber Bracing Ahead of Blaw Forms—Steam Shovel Excavating Between Sheeting and Piling—Pouring the Sewer Invert Behind the Steam Shovel.

The Argyle Street Sewers, Chicago

The City of Chicago constructed a total of about 70½ miles of sewers during the year. Of these about 65 miles were tile pipe and the balance of 5½ miles were brick with a small amount of concrete. Two large systems completed this year are worthy of special mention. The Argyle Street (Norwood

Park) System was constructed to drain the northwestern portion of Chicago. Much of the territory included in this drainage district is unsettled and construction was comparatively simple. As the sewer was designed to relieve some existing systems, several interesting features were presented. Brick sewers in sizes ranging from 9 ft. down to 2 ft. were constructed. The total length of sewer was about 14 miles. The ingenious use of wiers in diversion chambers, carries the flow of sewage during periods of little or no rain to the North Shore Channel of the Sanitary District. Provision is made in these chambers so that, during periods of storm or great flow, excess water is discharged into the North Branch of the Chicago River. H. J. McNichols Company were the contractors on this work. Construction covered a period of two years.

The Rockwell Street Sewers, Chicago

The Rockwell Street System was constructed to afford relief to a large area on the west side. It is one of two similar systems designed to afford relief to a large portion of the west side. The other, known as the Albany Avenue System, was constructed some years ago. The complex nature of construction on such a system of sewers, when constructed in a developed portion of a large city is very interesting. No less than 17 public utilities or functions were encountered and the maintenance of service from these is a great problem. Many streets were paved and the removal and replacement of pavements was a large item in the cost. A portion of the Rockwell Street System was constructed in tunnel. The amount of the contract was about $317,000 and construction covered a period of two years. Circular brick sewers in sizes ranging from 10 ft. down to 4½ ft. were built. John W. Farley was the contractor.

Relief Sewer Program Covering 20 Years

The City of Chicago, through its Board of Local Improvements, has announced a program for the construction of relief sewers for that city, covering a period of twenty years. This is in addition to the work contemplated for the natural expansion and growth of the city. Careful studies made of existing systems of sewerage and the development taking place within the city, indicate the general outlines of districts which will need relief. Plans are formulated and details being worked out on a regular schedule. Such a program indicates the earnestness and zeal with which the sewerage situation in a large city is being watched by its engineers.

Rapid Work on Tile Pipe Sewers

The construction of a large amount of 12-in. and 15-in. tile pipe sewers in Chicago has enabled the contractors to develop and standardize their organization for this particular class of work. As an instance of this. it is interesting to note the record made by The Ryan Company on November 20, 1917. In an 8-hour day they excavated trench for, and laid 1,338 ft. of tile pipe sewer of the sizes mentioned. The average cut was slightly in excess of 7 ft. An Austin excavator was used.

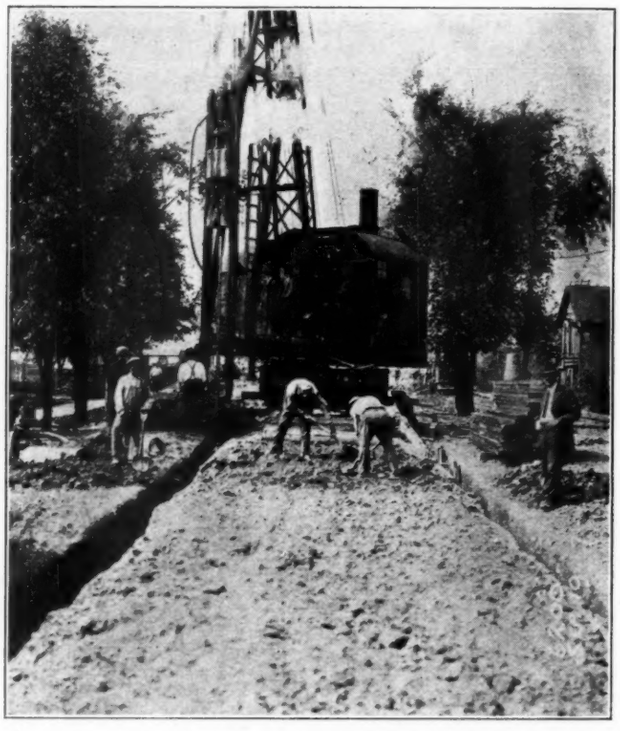
Fast Work at Camp Grant

For rapid construction work the establishment of the U. S. Cantonment at Camp Grant can be cited as an example. On July 1 this site was forest, tilled land and pasture. On October 1 it was a city having hundreds of buildings and possessing water works, sewerage system, heating and lighting plants and miles of paved roads and streets. The sewers are on the separate system plan and are designed for a population of 42,000. Numerous outlets were built, thus avoiding any excessive cuts. These outlets are carried, partly to the Rock River, and partly to the Kishwaukee River, cast iron pipe being used from the last manhole to the thread of the stream. These streams were all ready heavily polluted and no attempt was made to protect them from pollution from the camp. A total of 26.6 miles of vitrified tile pipe, varying in size from 6 to 24 ins., was laid in cuts averaging 4½ ft. The ground was sandy loam and sand and gravel. Work started July 10 and was 90 per cent. completed August 20, the last 10 per cent. being done by Austin machines with a maximum of eight machines on the work, with the following results:

The average daily progress, all machines	545 feet
Best machine average	755 feet
Best day's work, single machine	1,700 feet

U. S. Naval Station Work at Great Lakes

With the large increase in population at the U. S. Naval Station at Great Lakes during the summer of 1917 the authorities decided to build a new sewage disposal plant. This plant, designed for a population of 30,000, is nearly completed and has a nominal capacity of 3,000,000 gals. of sewage per day. It consists of sludge separating tanks followed by aeration, sedimentation, sterilization and filtration.



PILE DRIVER DRIVING SHEETING AND PILES AHEAD OF STEAM SHOVEL ON OPEN CUT SECTION OF 10-FT. SEWER, EVANSTON, ILL.

There are three parallel sets of hopper bottom tanks, each tank being in two compartments, which are separated from each other by a sludge digestion chamber. The tanks are similar to those designed by Alvord and Burdick for the City of Madison, Wis., about four years ago. They are located on top of the bluff and about 50 ft. above the water level of Lake Michigan. The effluent from the tanks passes over a series of aerating steps built into the slope of the bluff and thence through a mechanical filtration plant of the water works type, including a concrete mixing chamber, sedimentation basins and four mechanical filters.

The tanks and aerating steps have been in operation for about three months. The filter plant, together with the mixing chamber and coagulating basins, were placed in operation by the middle of January.

The operation of this plant is producing some very interesting results. During the month of December, owing to the discharge of waste water from the steam heating system, the flow through the separating tanks and digestion chamber was at a temperature of about 90 degrees F. There was little loss in heat during aeration down the steps to the filtration plant. The effect of such a temperature on the effluent should be very

interesting and it is hoped more detailed information can be obtained on this matter later.

This plant, as well as the sewer, water, heating and lighting systems at Camp Grant were designed by Alvord and Burdick, Consulting Engineers, Chicago. John Griffiths and Sons were the contractors for the plant at Great Lakes. All constuction in connection with the Cantonment at Camp Grant was performed by Bates and Rogers, contractors, Chicago, working on the "cost plus a per cent. basis."

Cost Keeping

Increasing attention is being given to accurate cost keeping by engineers in charge of work, with a view of arriving at reliable unit costs for the different kinds of work embraced in the contracts.

It is worthy of note that the Sanitary District of Chicago has recently taken steps to establish a Cost Keeping Division, in charge of an Assistant Engineer. The results possible from such a department are only limited by the field covered. As this field is very large with this particular organization, the results are sure to be very valuable. It is to be hoped that this example will be followed by other great construction organizations.

Considerations Affecting the Choice Between the Separate and Combined Sewer Systems

By Paul E. Green, of Marr, Green & Co., Consulting Engineers, 17 N. La Salle St., Chicago.

When the officials of a community have decided that a sewer system is needed and an engineer is engaged for the purpose of designing such a system, the first question which must be settled is the type to be installed. Broadly speaking, there are two types of sewer systems; that is, the separate and combined. The sanitary sewer, which handles interior wastes exclusively, requires that it be supplemented by a system of storm water drains. The combined system is, as the name signifies, one that not only takes care of the interior wastes, but all street and other exterior drainage. The combined sewer must, therefore, take care of from 20 to 50 times as much waste liquid as the sanitary system, and this means that the sewers themselves must be proportionately larger. Storm water drains will be of the same size as the combined sewers if they cover the same territory.

Conditions Governing Selection of Type.

Conditions governing the selection of type of sewer may be grouped generally under the following heads, to-wit: Population—its character and its growth; topography; the character of the soil, that is, whether or not it is underlaid by rock, etc.; the disposal of the sewage, and the condition of the streets.

Population

A very important factor in the design of a proper system is the population. If the community is a small one and has not had any appreciable growth for many years, and if its situation is such that it is not likely to increase materially in population, the problem is considerably simplified. Most of the inhabitants will then be property owners. The property will not have been bought as an investment or speculation, and the sewers, if put in, will be largely a convenience and possibly a sanitary necessity. The actual installation of the system will not materially increase the value of the property, and it will be difficult to assess such property a large amount.

Topography

Furthermore, if in this community the topography is such that the natural drainage is good and the people are not much troubled with low swampy spots, the decision will wisely be for a simple sanitary sewer, which may be constructed at a minimum cost. On the other hand, if a community is an industrial one, rather close to a larger city which has a combined system, it is probable that even under extreme circumstances the more expensive combined system would be the one to put in, unless the question of disposal is such a grave one that it would be the governing point.

Abuse of Separate Systems

In cases like the two cited above, the decision is relatively simple. The problem becomes much more complicated when the extremes are not so apparent, and then many other things must be taken into consideration, not the least important of which is human nature. Most State Boards of Health advocate the separate system, but the average person fails to discriminate between them. It will almost invariably be found in a few years after a sanitary system has been installed that not only is roof water being led into the mains, but that even the city authorities are connecting street inlets to it, and when this system has also a disposal plant in connection, the result is frequently disastrous. After every storm, sewage is backing up into the basements of houses, and about this time a demand for a system of storm water drains is voiced. As most of the property owners have a very distinct recollection of what they paid for the sanitary system, and as the assessment for a storm water system is generally considerably heavier, there is liable to be very lively controversies before the question is settled.

Length of Outfall Sewer

Another very important point to be considered is the distance to a proper outlet for the sewage. If it is several thousand feet from the corporate limits to a proper disposal site, the expense of carrying a large sewer such a distance is very material and may be so great as utterly to discourage the city officials. However, as an assessment proposition, it has been found that people as a rule are much more willing to pay an assessment for the combined system of sewers than they are for a sanitary one, even though the assessment for the combined system may be two or three times as great as is required for the alternative.

Where the Choice Is Easy

There is one situation in which it is nearly always advantageous to put in a combined system. This is one in which the entire community is underlaid by rock. It is almost as expensive to excavate narrow rock trenches as the wider trench required for the larger combined sewer. It will be found that the unit price of rock excavation on large sewers is decidedly less than that for small ones.

Proper Financing

Proper financing of such an improvement requires careful study. A great many mistakes have been made in the past in this matter. The first time a system is put in, the easy way is to pay for it by means of a general bond issue. A more equitable method, however, is to put it in by special assessment, which can be done in nearly all of our states, though the laws of some are defective. This is on the theory, of course, that the property that is benefited should pay for the cost of the improvement. A further great advantage is that the city as a whole is always in much better financial condition when improvements are put in under this plan than when they are financed by means of a general bond issue. Once having started to build improvements from these bond issues it is very difficult indeed to change. People that have not as yet had an improvement cannot understand why they should pay their special assessment when other parts of the community have had their sewers put in for them. The result is that the municipality is always in financial trouble, as the bonding power is soon exhausted. Improvements are stopped in a few years and the progress of the community is retarded.

Study the Money Market

In those states which permit a variation in the number of years or installments for paying special assessments it will repay the engineer to study the money market. At times five-year paper is better than ten-year, and then the reverse is true. It will depend on the value of money at the time.

The Proper Installation and Maintenance of Automatic Sewage Siphons and Ejectors

By S. Fischer Miller, President Pacific Flush-Tank Company, Singer Bldg., New York, N. Y.

Apparatus usually receives, at the hands of the designer, considerable thought and study in standard construction and standard uses; also, in special uses a further amount of study is required to adapt standard equipment to the purposes intended. Such study and research varies in direct proportion to the personal equation of the manufacturer. It can be stated, however, as quite a matter of fact, that no apparatus is offered for sale or installation for any unsuitable use, if the manufacturer is fully advised in advance.

It is obvious, therefore, that all parties contemplating the use of automatic equipment, such as sewage disposal apparatus, ejectors, etc., should avail themselves not only of the literature the manufacturer prints, but the personal services of the same manufacturer in an advisory capacity, before such equipment is ordered through the contractor.

Precautions in Design and Installation

In designing plants requiring apparatus, full consideration should be given for growth in volumes of sewage to be handled and the character of the sewage, in order that the apparatus may be adequate in size to perform the duty required, and in many instances, particularly in ejectors, duplicate installations, each equal to the maximum requirement, should be installed.

In installing apparatus of this character the municipalities should employ the manufacturer to exercise a certain amount of supervision, as may be required, to see that the work is performed in such a manner that the apparatus will satisfactorily operate and continue to operate.

The municipalities should require full sets of assembly drawings of all such apparatus, and, before the contractor is discharged and the apparatus accepted, the mechanic to be placed in charge of the plant should be carefully instructed in the use of the apparatus.

Specific Suggestions on Maintenance

In the maintenance of such plants the municipalities are under the disadvantage of frequently changing their employes, and it must be obvious that an unskilled operator may not be able to secure from any apparatus the results obtained by his predecessor, who was able to operate the plant and understood thoroughly the basic principles of the machinery.

A record should be kept at the plant of the performance of the apparatus, the same requiring little or no attention, except possibly after a very heavy storm in plants where the sewer systems tributary are combined and not separate.

All moving parts apparatus requires considerable attention at the place of wear, and non-moving apparatus requires occasional cleaning.

Pits and pockets containing apparatus are likely to sludge up, and should be pumped out and kept clean at the bottom, at comparatively regular intervals.

Plants should be more or less protected from loose leaves, sticks, and rubbish generally, which may be thrown into the pits, and this is accomplished by covers over the apparatus, with open joints for ventilation.

Plants that are exposed to freezing in very cold exposures should be protected during the winter months.

It would be wise for each municipality to employ the original designing engineer to inspect its plant at intervals of, say, once in sixty days for large plants, and possibly once in six months for smaller plants. The expense for such inspection would be well justified, as errors in operation would be corrected and results obtained continuously for which the plant was originally designed.

The manufacturer of the apparatus furnished and installed could properly be employed in the larger plants to make examinations, rather than to permit an unskilled operator to conduct his own experiments, or to alter the apparatus without consulting the manufacturer.

In a general way the simpler the apparatus is, the more readily it is comprehended by the average caretaker, and the more reliable the manufacturer is, the more serviceable the apparatus will be.

Summary

In summarizing, it would appear to be very essential that maximum volumetric conditions be thoroughly taken care of in the original design; that loss of head necessary for successful operation be also thoroughly understood and arranged for; and, further, that the apparatus itself be observed at regular intervals, and all chambers containing the same be protected from rubbish of all sorts, and frost, and kept clean, so that the equipment may not fail.

All hydraulic apparatus requires to be installed in watertight compartments, and the outfalls from the plant must be able to take off the sewage at the maximum rate, and the outlets remain free at every point.

Municipalities owning sewage disposal plants should not hesitate to communicate with the manufacturers of all such apparatus, providing themselves with proper assembly drawings and literature pertaining to the special apparatus furnished, and its engineering department should be familiar with these also.

WATER WORKS DESIGN AND CONSTRUCTION

The Range of Results Obtainable in the Use of Concrete in Water Tank Construction

By C. C. Whitaker, Consulting Engineer, Forsythe Bldg., Atlanta, Ga.

The application of reinforced concrete to artistic architectural work is not new; in fact, the history of Ferro or reinforced concrete seems to indicate that its first use was the construction of an ornamental flower pot or urn, which, when further considered, amounted to simply a small tank.

Possibilities of Concrete in Tank Construction

It is the purpose of this article to show from the standpoint of tank construction what has been accomplished in this type of structure by the utilization of concrete, and the vast possibilities that exist in this material when rightly used.

From time to time very interesting accounts of reservoir or tank construction in reinforced concrete have appeared in a great number of publications, and different parts of the work have been featured to a more or less extent.

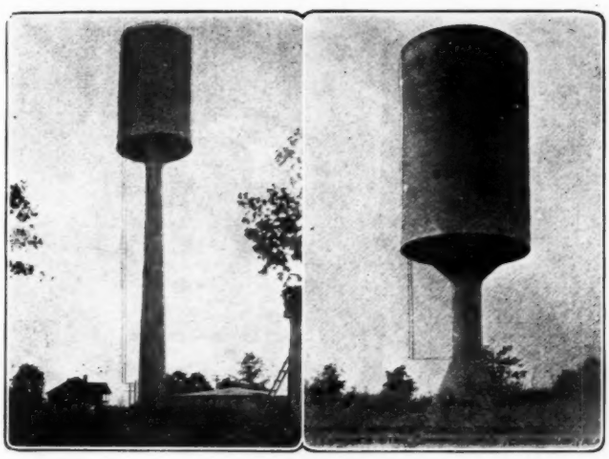
The actual designing methods used in all work of this kind vary, though in general they amount to simply the utilization of long-accepted theories applied to a new condition. It is not the purpose of this article to deal to any great extent with the technical features of tank or standpipe design, or methods of construction.

The architectural details that can be accomplished are

so vast in their number and types that it is simply a case of the ingenuity or artistic talent of the designer.

Common Types

There are very few that have not seen the ordinary, every-day standpipe and tank tower of concrete holding either a tank of concrete or some other type of material. Some years ago, and not so many at that, a structure of this kind was looked upon as a novelty. Those of us, however, that were keeping abreast of the times not only saw the stability and far-reaching effect of concrete for uses of this kind, but realized without question that for this type of work concrete had come to stay, and still further, that its possibilities were unlimited.



VIEW OF REINFORCED CONCRETE WATER TANKS OF GOBLET TYPE AT BAY MINETTE AND NORTHPORT, ALA.

An ordinary square leg or otherwise straight-leg tower or bent construction is one that needs no comment. We, therefore, pass this type of construction for one that is going to seem like a very daring design.

Novel Tanks at Bay Minette and Northport, Ala.

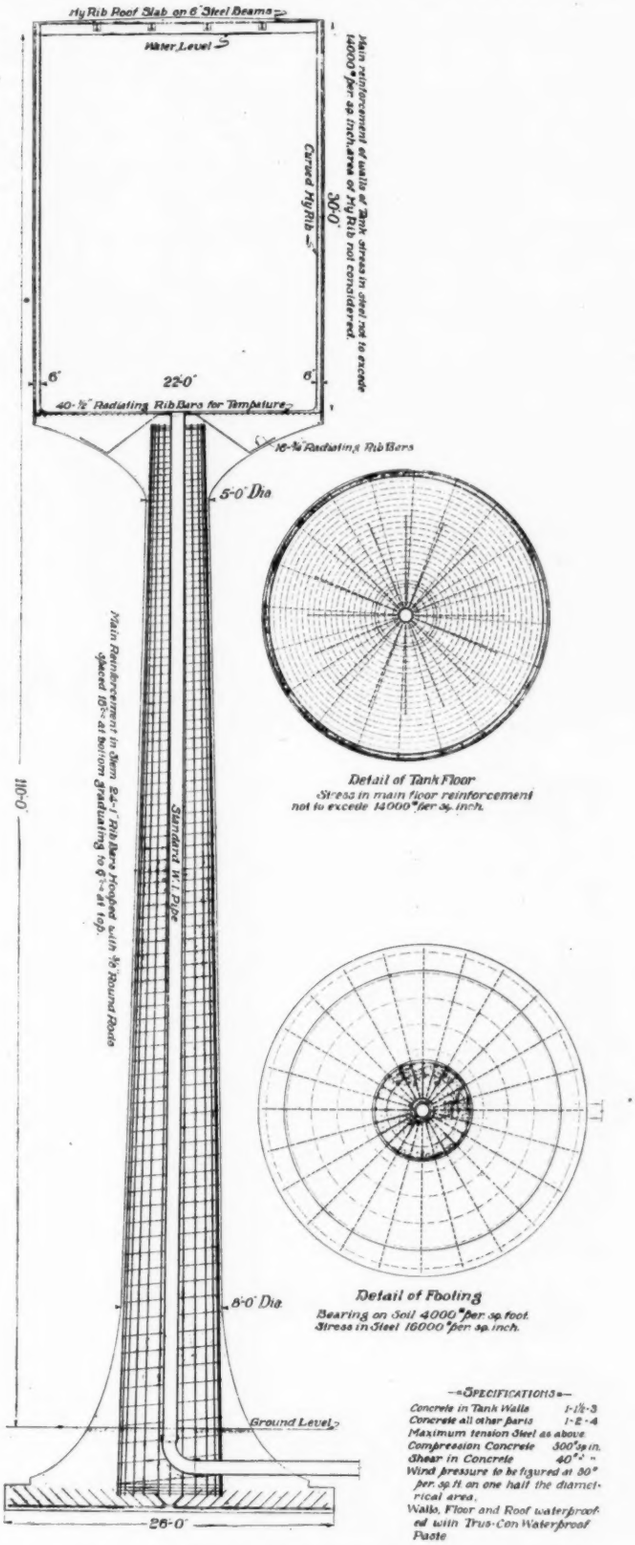
By referring to the cuts herewith of tanks at Bay Minette and Northport, Ala., and the details of the former, it will be noted that by enlarging on an ancient kind of water receptacle a very novel as well as stable and pleasing type of reservoir design has been accomplished. These tanks are known as goblet tanks, owing to their likeness to the drinking vessel of the same name. By referring to the reproduction of details it will be very easily seen that what at the first glance appears to be a very daring design is far from such and by the use of standard practice and accepted theory has reduced itself down to simplicity itself.

The tank at Bay Minette is 80 ft. from ground to tank bottom, and that at Northport 30 ft. from ground to tank. Both tanks are 30 ft. in depth and of 80,000 gals. capacity. The overall heights are 110 ft. and 60 ft., respectively.

Use of Hy-Rib in Bay Minette and Northport Tanks

The barrel of the Bay Minette (Ala.) tank was formed by the use of two lines of curved Hy-Rib (one inside and one outside) the Hy-Rib acting as a permanent form and at the same time a part of the reinforcement. The inner line of barrel of curved Hy-Rib was waterproofed cement stucco, using the integral method, with Trus-Con Waterproofing Paste. This was allowed to set up, thereby performing two duties in the construction, one being the waterproofing of the inner face and the other the permanent closed form. When it is taken into consideration that this tank stands 110 ft. above the ground the advisability of this method of forming can very easily be appreciated. When water was turned into the tanks at full pressure there were no signs of leakage.

In the forming of the barrel of the Northport (Ala.) tank, which is considerably lower than the Bay Minette tank, it was found advisable to use only the curved Hy-Rib for the


Hy Rib Roof Slab on 6" Steel Beams
Water Level
Main reinforcement of walls of Tank stress in steel not to exceed 14000# per sq inch area of Hy Rib not considered.
Curved Hy Rib
30'-0"
6"
22'-0"
6"
40-½" Radiating Rib Bars for Temperature
16-¾ Radiating Rib Bars
5'-0" Dia
Detail of Tank Floor
Stress in main floor reinforcement not to exceed 14000# per sq. inch.
110'-0"
Main Reinforcement in Shell 84-1" Rib Bars Hooked with ⅜" Round Rods spaced 10½" at bottom graduating to 6½" at top.
Standard W.I. Pipe
8'-0" Dia
Detail of Footing
Bearing on Soil 4000# per sq. foot.
Stress in Steel 16000# per sq. inch.
Ground Level
26'-0"
SPECIFICATIONS
Concrete in Tank Walls 1-1½-3
Concrete all other parts 1-2-4
Maximum tension Steel as above.
Compression Concrete 300# sq. in.
Shear in Concrete 40# "
Wind pressure to be figured at 30# per sq. ft. on one half the diametrical area.
Walls, Floor and Roof waterproofed with Trus-Con Waterproof Paste

DETAILS OF DESIGN OF REINFORCED CONCRETE TANK OF GOBLET TYPE AT BAY MINETTE, ALA.

inner form, which was treated the same way as the Bay Minette tank, and to use metal forms for the outside.

Severe Test of Stability of Bay Minette Tank

About the middle of June, 1916, one of the most severe storms that has ever visited the Gulf Coast section of the

country swept over Bay Minette, Mobile and Northport. During this storm, according to the Weather Bureau reports, the wind reached a velocity of more than 80 miles an hour.

The Bay Minette tank was, comparatively speaking, green as it had then only been completed a short time. In the town proper of Bay Minette a great many residences and other buildings were unroofed. Quite a number of structures were completely demolished and a vast amount of other damage done by the wind. The correctness of the assumptions of this design has without doubt been proven as both of these tanks are now standing and show no signs of any weakness due to the tremendous pressure put upon them.

As a further demonstration of the stability of this type of structural design; these tanks were in no way guyed or stayed to the ground and relied entirely on the stem for the transmission of the pressure into the footings, which in turn must have been correctly designed against overturning.

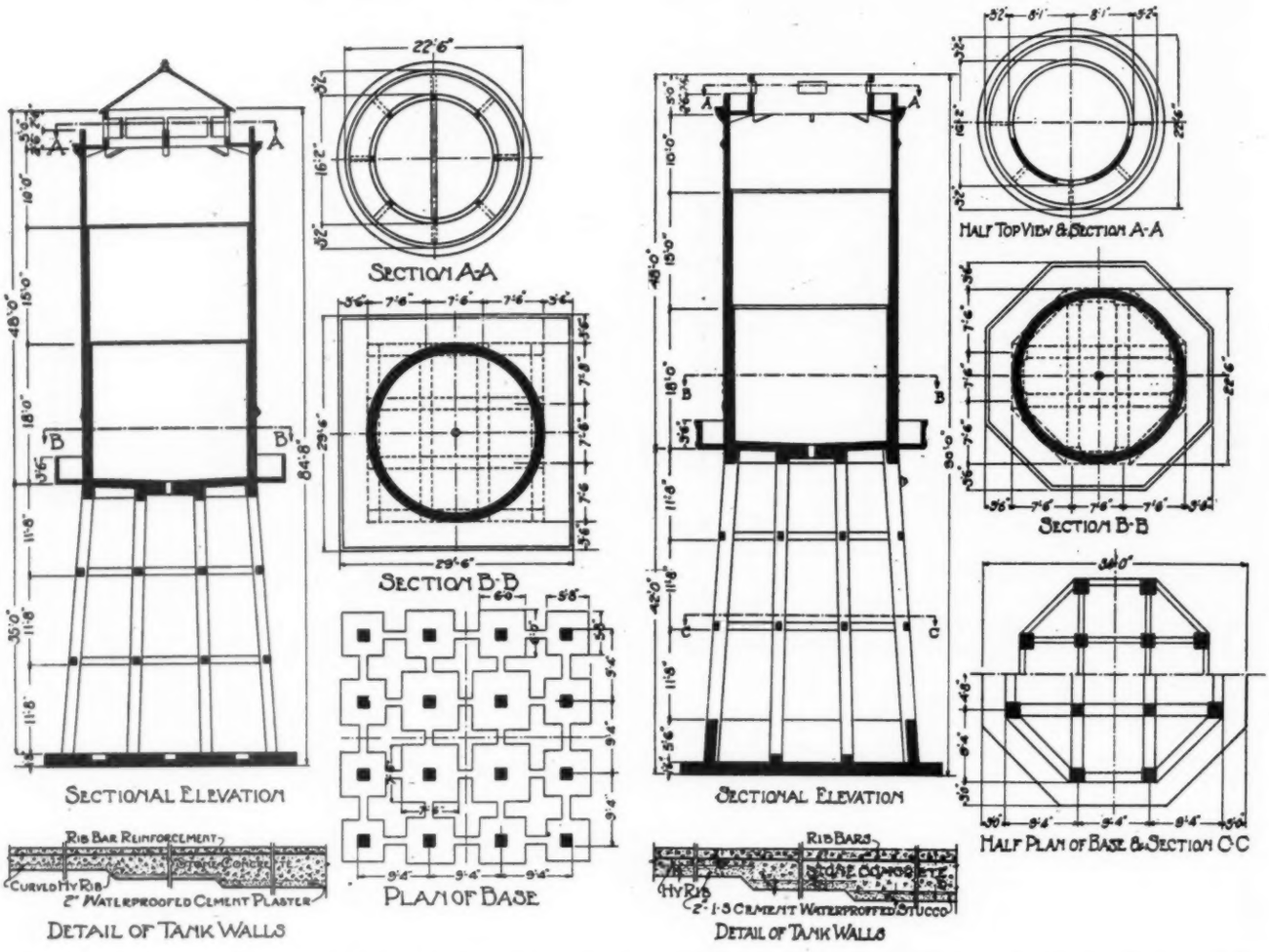
Ala., Mr. L. H. White, President and Chief Engineer. The tanks shown were constructed by them.

Architectural Possibilities in Use of Concrete

There is no reason why, with the architectural possibilities in concrete work, that tanks or water supply systems in large and beautiful estates should not be made one of the most beautiful parts of the general scheme of improvement, rather than an eyesore; as has been the case for a number of years and will almost always be the case in the old, antiquated type of either stave tanks on pipe bents or steel tanks on the same or kindred type of towers.

The Alton Beach Tank at Miami, Fla.

One of the first sections to realize the necessity for departing from the old type of structure was Miami, Fla., on the Carl Fisher Estate improvements, Alton Beach. In this



REINFORCED CONCRETE WATER TANKS NOS. 1 AND 2 AT ALTON BEACH, MIAMI, FLORIDA. EACH TANK OF 100,000 GALS. CAPACITY. KAHN SYSTEM OF REINFORCEMENT USED.

As a matter of interest, it may be well to mention that both of these tanks were awarded in direct competition against steel tanks on steel towers and that in both cases there was a saving in first cost realized.

There is nothing architecturally beautiful about these structures, but the oddity of the design lends interest to the general condition and makes possible a tremendous saving in room space, thereby recommending the general adoption of this type of structure for commercial or manufacturing water supplies.

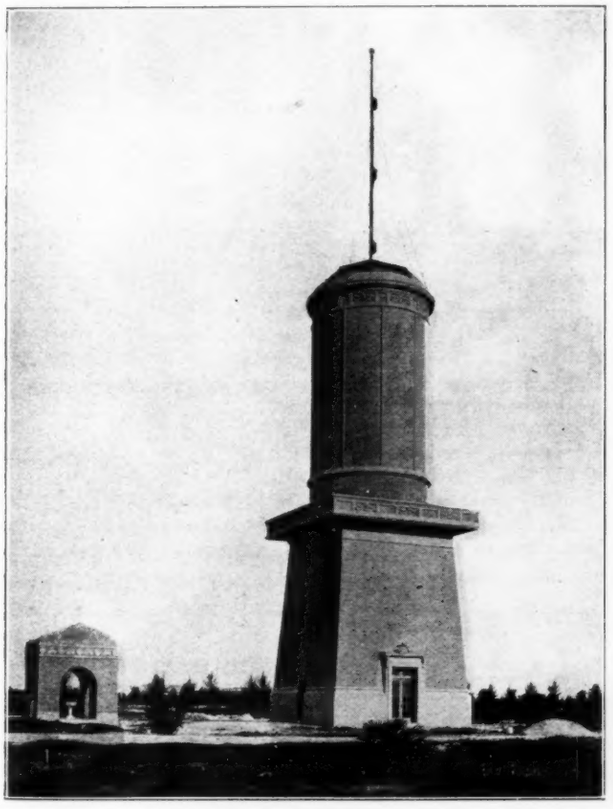
The patents of the design for these goblet tanks are owned by the Concrete Steel Construction Company of Birmingham,

development are located private residences and home estates in which the general type of structure has run in actual cost of production from $20,000 to untold thousands, and no money, in a great many cases, has been spared to make them not only most modern, but as beautiful architecturally as possible.

The water supply system, which had been taken care of largely by small pumping stations and private wells, resolved itself down, from the fire protection standpoint if nothing else, to a large central supply. As the general topographical layout of the ground is perfectly flat, having an altitude of only about 9 to 12 feet above high water, it will very readily be seen that tower construction had to be adopted for even

pressure, or the maintenance of a very expensive and sometimes undependable pump system.

It was, therefore, decided to construct an elevated standpipe or reservoir. Bids were taken on a steel tower and steel standpipe. This at the best would never have been anything except a standpipe, allowing but limited chance of beautification, and would always have been a constant eyesore to this community, particularly so on account of its being the tallest object on the sky line and, therefore, the most noticeable. It was, therefore, thought advisable to take bids on concrete construction with the final result that this class of material was adopted.



VIEW OF 100,000-GAL. REINFORCED CONCRETE WATER TANK AT ALTON BEACH, MIAMI, FLORIDA.

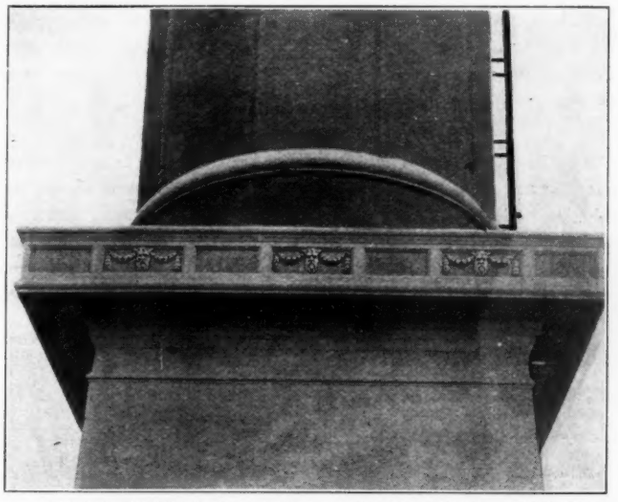
Through the able management of the gentleman intrusted with this work, Mr. August Geiger, Architect, of Miami, Fla., and the co-operation of Mr. John B. Orr, plasterer, a very pleasing architectural result was obtained. It may be worth mentioning that a saving, though slight, in cost was effected by the use of a reinforced concrete tower, curtain walls in terra cotta tile and a reinforced concrete tank.

Application of Hy-Rib in Alton Beach Tank

The interior barrel of this tank was laid out in a curved Hy-Rib, which was placed from tthe base up to nearly the offset line of the different thicknesses of the tank and which ultimately acted as the interior forms of the tank.

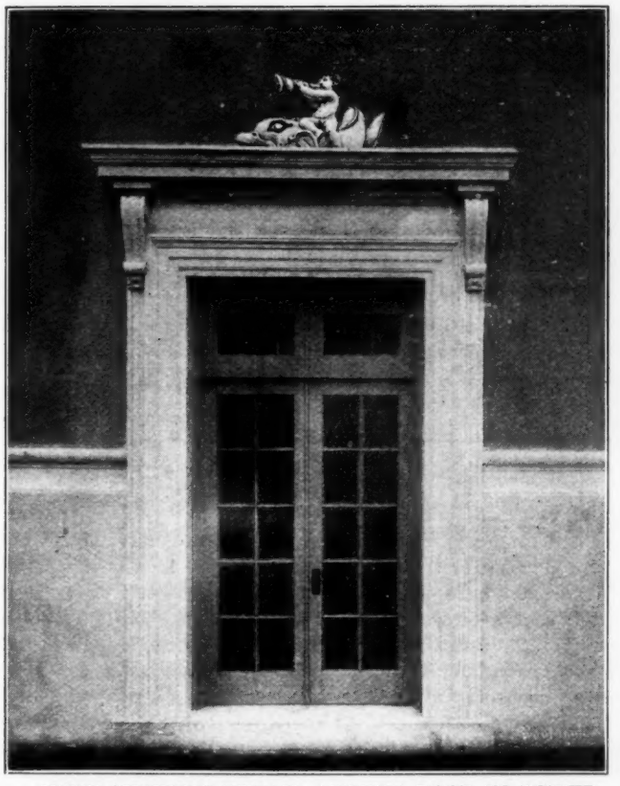
This Hy-Rib barrel was built in three courses of waterproofed cement stucco, considering the barrel as separate and distinct from the structural walls of the tank, reinforcing this not only with the Hy-Rib in the horizontal direction, but vertically with pencil rods against any possible expansion or contraction. This permitted of carrying the waterproofing in the floor of the tank up in a positive unbroken line from the bottom of the tank to the top, as each course of stucco or plaster work was laid in such manner as to prevent there being a lap or joint coming over the same point in any two courses. In other words, at no place on the inner surface of this tank is there less than two unbroken courses in thickness of cement waterproofed stucco.

The gauge of Hy-Rib was varied from a 22 to a 26, each division having been reduced toward the top, starting at 22, 24 and 26 in the top line.



VIEW SHOWING DETAIL AROUND THE BALCONY OF THE REINFORCED CONCRETE WATER TANK ON CARL FISHER'S ESTATES, ALTON BEACH, MIAMI, FLA.

By referring to illustrations of the tank at Alton Beach it will be noticed that this tank or reservoir has been turned into probably one of the most beautiful pieces of architectural construction on the island. The finish is of stucco. Some



VIEW SHOWING DETAIL AROUND DOOR IN TOWER OF REINFORCED CONCRETE WATER TANK, MIAMI, FLA.—NOTE STUCCO FINISH.

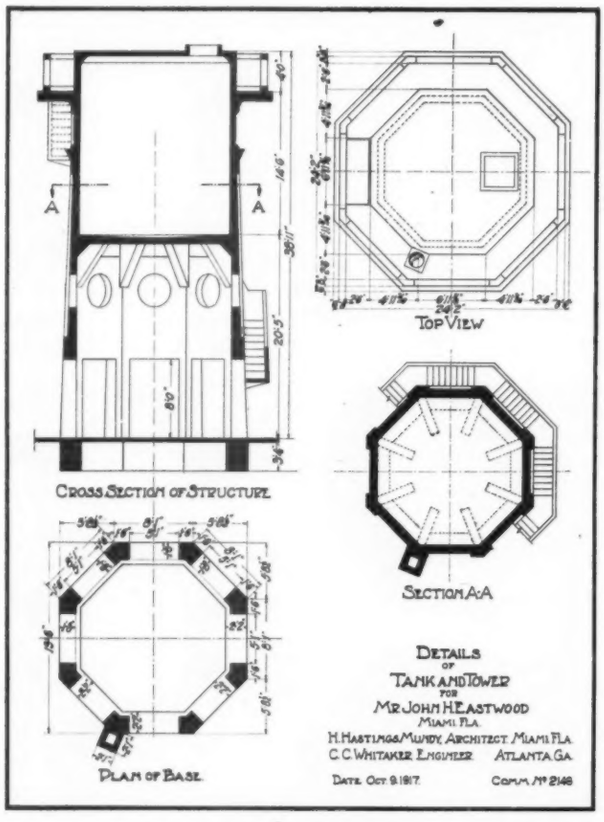
parts of this work have been accomplished by precasting the ornamentation; other parts by run moulds with the base or background in a rough cast stucco work. The color scheme adopted of fawn background with lighter moulds and white base and door frame adds greatly to its beauty.

A great deal of credit is due Mr. Orr, who is an artist in more ways than one in the use of stucco and ornamental plaster work, as his co-operation with Mr. Geiger made it possible to produce a structure which from a standpoint of beauty possibly is not surpassed by any structure of its kind in existence.

This was the first of this type of structure constructed and has proven so satisfactory in every respect that, with minor changes, a second tank of the same type is now nearing completion.

The Eastwood Tank at Miami, Fla.

Another type of ornamental tank or reservoir that shows still further the possibilities of reinforced concrete in this class of work is the reservoir or house supply tank designed by Mr. H. Hastings Mundy, Architect, also of Miami, for Mr. John H. Eastwood's estate in that city. A construction view of this structure is shown herewith, and, in the hope of showing still further the elasticity of this kind of designing work, a reproduction of the architect's detail has been used.



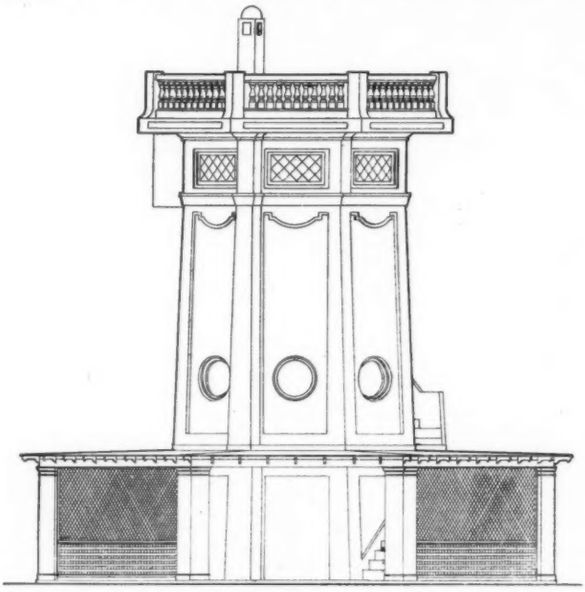
EASTWOOD REINFORCED CONCRETE TOWER AND TANK AT MIAMI, FLA.

This structure will serve several purposes. Primarily it is the source of water supply for the entire building equipment for the estate; it is also an observatory or lookout and at the ground level can be used as a garage or for many other purposes.

The general architectural appearance of this structure will be very pleasing, most particularly as it harmonizes with and is of the same general architectural type as the remainder of the structures of the estate.

Water-Proofing Concrete Tanks

It may be of interest to mention that the waterproofing of all of these structures has been of an integral nature, either throughout the entire mass of concrete in the walls and floor of the tank or by the construction of an inner waterproofed stucco shell on curved Hy-Rib lath. In all cases this type of waterproofing of the tank barrel has proven satisfactory and has allowed of a marked saving in time and first cost. The adverse condition that nearly always prevails due to the use of any type of membrane inner coating was eliminated by the integral waterproofing. All materials now on the market of a membrane nature applicable for this purpose are either a composition of coal tar and mineral oils to which in a very large number of cases a creosote compound is added, or a material to which is added other chemicals, as a usual thing of a mineral nature. Any one of these compounds is bound to taint the water more or less, particularly if they are used simply as a membrane and not protected on the inner face by a stucco, which should be integrally waterproofed, thereby preventing the pollution



ARCHITECT'S DRAWING OF EASTWOOD REINFORCED CONCRETE OBSERVATORY AND WATER TANK—TOWER AT MIAMI, FLA.

CONSTRUCTION VIEW OF EASTWOOD REINFORCED CONCRETE OBSERVATORY AND WATER TANK TOWER AT MIAMI, FLA.

of the water contained in the tank. Too much attention cannot be given to this feature of the construction as the entire success of the venture or problem depends on this part of the design, specifications and workmanship.

It has been the purpose of this article to bring to the attention of the many readers of this paper not only the advisability of tank construction in reinforced concrete, but to show the wide range of results that can be obtained by its use.

There are so many points of advantage in the use of this material for this purpose that it hardly seems necessary to go over them. A word of caution, however, may not be amiss —do not think that because a contractor can construct a concrete wall he can necessarily construct a concrete tank, for often this is not the case. One cannot take too many precautions, both in the design and the construction of work of this nature, to insure a satisfactory structure.

PAVEMENT DESIGN AND CONSTRUCTION

Bituminous Pavements, Adaptable to Various Conditions, With Special Reference to Type and Thickness

By L. Kirschbraun, Ch. E., Director Chicago Paving Laboratory, 160 North Fifth Avenue, Chicago

This discussion is restricted to that class of bituminous pavements more generally employed in high-grade construction, in which the wearing surface is produced by mechanical mixture under more or less controlled conditions.

Some Pavements Foredoomed to Fail

It has been stated that many a bituminous pavement has been a failure before being actually constructed. This expression is frequently only too true, and apparently refers to the more or less prevailing custom in municipalities of determining upon types of bituminous pavement, with little or no consideration or thought of the conditions involved. In some instances, the deciding factor of selection is the persuasive effect of ill-judged promotion, which is often more interested in pushing a certain type of construction and meeting certain competition than concerned with the adaptability of the proposed construction to conditions in view.

Without careful predetermination of type of pavement, based on wide experience and intimate knowledge of conditions, all subsequent value of specifications, plans and actual care of construction may be practically nullified.

Underestimating Traffic Conditions

A very frequent mistake which is made is to underestimate traffic conditions to which prospective pavements will be subjected. This refers not only to volume of traffic which will use the pavement immediately after completion, but also to volume and weight of traffic which must be anticipated by changing conditions. The tendency to underestimate traffic is so general that engineers who design or select types of bituminous pavement should consider this foctor to the extent that errors of judgment, if any, should be in the direction of safety, resulting in building too well rather than not quite good enough. Pavements which may be thoroughly satisfactory under certain conditions of traffic may fail sharply and quickly when subjected to an intensity or weight of traffic which the type or thickness of construction is unable to accommodate.

Basing Design on Judgment and Experience

The designing of engineering structures is usually predicated upon knowledge of the exact forces to be imposed and upon scientific data with reference to the properties of various materials and combinations to withstand predetermined conditions. In designing or selecting a pavement, however, no such data is available, either as to the exact conditions imposed, or as to the ability of the materials employed to comply with these conditions. The selection of bituminous pavements, therefore, has been left to experience rather than to exact determination. In other words, the planning of a pavement for given conditions still remains a matter of judgment in which the variables are type of elements and their thickness. In spite of this, however, an analysis of the function of elementary structures composing our pavements, together with a general understanding of the action of traffic forces, will assist in the determination of the type and thickness of pavement to be selected. Until the vast field of research dealing with the mechanics of traffic and the physical behavior of paving materials under the forces imposed by traffic is thoroughly explored, there is afforded no means of design or selection of bituminous pavements other than experience and good judgment applied in the light of general principles of traffic action.

Traffic Forces

In considering the action of a pavement structure designed to sustain traffic, it must be remembered that in the final analysis, aside from ease of traction, a pavement is only a means of transferring indirectly to the subgrade the forces of traffic.

The forces imposed by traffic are variable, more or less undefined, and may only be described in general terms. Pavements must carry live and dead loads of both rubber- and iron-tired traffic. Dead loads call into action the element of compression, and requires distribution of the loads to the subgrade without breaking through the pavement structure. The action of live loads in addition results in impact which tends to shatter the bond between the particles of aggregate. There are developed thrusts, proportionate in intensity to speed, weight and nature of springs and tires with which the vehicles are equipped. Such thrusts give rise to horizontal components in the direction of traffic, tending to move the surface on the base. The action of moving traffic brings into play attrition and compression of more or less plastic surface ahead of the wheels. A more recent effect of great intensity of light motor vehicles is observed in the tendency to produce lateral displacement of the surface, resulting in grooving or rutting of the pavement through internal movement of the plastic surface to either side of the rounded tire, as illustracted in the accompanying half-tone. The cause of this action may be well illustrated in observing the wheel of a motor car as it passes over a wet pavement. It will be noticed that the advancing wheel, with its rounded tire, exerts a force which displaces or splashes the water laterally on either side of the tire. This force, acting upon the plastic mixture, produces ruts in a similar manner by lateral displacement where traffic is confined to light motor vehicles only.

A discussion of the adaptability of various combinations of pavement elements to withstand the traffic forces general-

ly outlined, and the effect of modifications of thickness in this direction will serve as a guide to selection.

Elements of the Pavement

The elementary structures of which a pavement is composed are (1) foundation, (2) intermediate course, (3) wearing surface. The function of the foundation is to support the wearing surface so as to distribute loads and shocks to the subgrade. The foundation may be of broken stone or macadam, concrete, bituminous concrete, mixed or poured, or old pavement, such as brick or granite block.

The function of the intermediate course is to provide stability for the wearing surface—means by which the wearing surface will be stiffened or reinforced against the tendency of traffic to produce forward displacement. This intermediate course is sometimes a paint coat, but more generally a binder of either the open or closed type.

SHEET ASPHALT SURFACE SHOWING GROOVES PRODUCED BY LARGE VOLUME OF LIGHT MOTOR TRAFFIC.

The wearing surface receives all traffic forces directly, transmitting them to the underlying structure, and must maintain an unbroken surface against shocks and impacts which tends to disintegrate it. The wearing surfaces are of variable type, based upon aggregates ranging from fine to coarse, with intermediate combinations, as in Topeka mixture.

Pavement Elements in Relation to Traffic Forces

It will now be pertinent to consider these various elements of the pavement structure, with a view to determining to what extent the various kinds or their combinations behave in connection with traffic forces previously described.

Foundations

Given a well compacted and well drained subgrade, any type of foundation referred to above may be prepared of sufficient thickness to transmit loads and shocks to the subgrade in such a manner as to provide against breaking down. Of the various foundations employed, that of Portland cement is most generally used. This will distribute loads to the subgrade with a minimum of thickness, and with least regard to unevenness of subgrade. On account of its strength and rigidity, it requires less complete contact with the subgrade than any other type of foundation. It necessitates least attention to details in construction. Broken stone, macadam and bituminous concrete foundation will distribute loads over less areas of subgrade than will concrete. No experimental data is available covering the distribution of loads to subgrade through these foundations, but from the general nature of the material it can be safely observed that the area of distribution through these various types of base will be greatest in the order named, i. e., concrete, bituminous concrete, macadam and broken stone. This distribution of loads, however, may be modified in the concrete base by the lack of flexibility which may concentrate upon high points in the subgrade an excessive load, causing the entire weight to be carried over points unsupported by the subgrade. On the other hand, a broken stone or bituminous concrete base will seek solid contact with the subgrade, bringing into play only forces of compression.

Concrete Foundations

Concrete foundations are usually made 5 or 6 ins. thick. Sometimes a 4-in. base is laid, but where unusual conditions of subsoil pertain or an unusually thick bituminous covering is employed, this latter depth of concrete base can hardly provide a sufficient factor of safety against constantly increasing loads. Even a 5-in. base, with 2½ in. of covering is now giving indication of proving inadequate in larger cities where light traffic streets are occasionally subjected to heavy truck traffic. The possibility of increasing the strength of a light base by richer mixture must be considered against an increase of thickness of a leaner mixture, the latter having the advantage of distributing the loads over greater areas of subgrade.

Broken Stone or Macadam Base

As a practical proposition, a broken stone or macadam base for bituminous surfaces should be of substantially greater thickness than concrete base to withstand similar conditions of traffic. This additional thickness should correspond to at least 50 per cent. increase over concrete. In addition, it is not desirable to use a macadam base without it having been subjected to traffic and permitted to shrink and compact until free from further movement. For this reason, a new macadam base is seldom employed as a foundation for a bituminous pavement, but an old macadam base of sufficient depth of metal and sufficiently compacted by traffic with suitable drainage becomes an excellent foundation. Given the equivalent of thickness as compared with concrete, it has the advantage in that expansion and contraction is taken up by the individual particles of the base. On the other hand, in the concrete base, these forces produce cracks at greater or less intervals which are duplicated in the top wearing surface with considerable readiness.

Bituminous Base

The bituminous base, mechanically mixed, may be considered an improved macadam. It has the decided advantage over other types of foundation of becoming bonded with the superimposed bituminous courses, thereby increasing the stability of the surface and preserving it from the action of water below. However, its use must be restricted to subsoil conditions which will permit adequate drainage and uniform support underneath.

Old Brick and Block Pavements

Brick and old block pavements, laid on concrete, macadam and sometimes upon other brick, have been very satisfactorily employed as foundation for bituminous surfaces. Such foundations have the advantage of distributing loads and shocks to even greater areas of subgrade on account of the added thickness of brick or block between the old base and the new surface. Such a foundation likewise is free from the tendency to produce cracks in the wearing surface. Its use must be restricted, however, to conditions where the brick or block are firmly anchored, and need not be distributed in the application of the wearing surface. A substantial element in the usefulness of such a foundation resides in the length of time it has been under traffic, and degree to which it has become consolidated and compacted—and in the case of 2-course brick, the character of the subsoil underneath. In the

latter construction, however, it is unwise to resurface a 2-course block pavement, unless traffic anticipated is assuredly of only the mildest character.

Intermediate Course

Only two types of intermediate course have been employed in recent years: First, a paint coat consisting of asphalt cement dissolved in a suitable solvent, generally naphtha; and, second, the so-called binder course, comprising a mixture of large aggregates with bitumen. The paint coat has been used very little, and its value, as a practical proposition, is problematic. It is difficult of application over a rough surface, such as concrete, having a tendency to collect in pools that remain solvent until after the surface has been applied. In order to insure adhesion to such a base as concrete, requires a condition of freedom from dust and moisture which is very seldom obtained. It has been more satisfactorily used in resurfacing over brick, and to still better advantage in covering old bituminous compositions. There the smooth surface permits uniform distribution of the paint coat and the solvent action of the paint affords opportunity for complete adhesion. It is therefore only in the latter condition that the paint coat should be used as an alternative for the mechanically mixed binder course.

Open and Closed Binder Course

Binder course has been of two types, open and closed. The closed binder is superior to the open type in that greater structural stability is secured and the voids are filled against compression of the wearing surface into them under traffic. The binder course induces stability for the wearing surface in two ways: (1) by frictional contact of its rough, large aggregate against the base; (2) through its mechanical structure, which, on account of the locking of the large aggregate, resists internal movement. In addition to acting as a stabilizing course, it has the function of a shock-absorbing medium. This latter function will be performed in proportion to the thickness of the course. It is therefore apparent that careful attention must be paid to the binder course, and its thickness and stabilizing character should be advanced in proportion to the intensity of traffic. The value of this binder course has not been fully appreciated in connection with the preparation of surfaces which of themselves do not have the internal or structural stability necessary to resist displacement.

Thickness of Binder Course

The thickness of binder course ordinarily employed is 1 to 1½ ins. It is questionable whether an inch of binder provides a sufficient safety factor under present conditions for even light traffic. With appropriate thickness of top, an inch and one-half of closed binder would provide a much more desirable minimum for light traffic, with all factors pointing to thickness of 2 to 3 ins. to satisfy more severe conditions.

Where bituminous base is used and a positive bond is secured between base and superimposed courses, no binder is necessary, inasmuch as the foundation itself acts as a stabilizing element.

Wearing Surfaces

The wearing surfaces, which actually carry traffic, and initially receive the forces imposed thereon, are characterized by size of aggregates employed, varying from fine aggregate, as in a sheet asphalt pavement, to a comparatively large stone aggregate, as in the true concrete types. Between the two extremes of fine and coarse aggregate lie several types of wearing surfaces, such as the Topeka mix and grit mixtures, with varying amounts of small stone. Sometimes these wearing surfaces are placed directly upon the foundation, and sometimes upon an intermediate course, depending upon the type and character of surface and the foundation.

Types of Wearing Surfaces

Various types of wearing surfaces are more or less advantageously employed in connection with different kinds of traffic. Traffic such as that of iron-tired vehicles, which exerts considerable abrasive action on a surface, is best resisted by that type of surface containing the finest aggregate. This is likewise true in connection with traffic in which impact, as well as abrasion, of iron tires plays a substantial part. Large aggregates under impact are prone to shatter, permitting the entrance of water and the subsequent more rapid destruction of the surface.

On the other hand, mixtures of fine aggregate do not possess in themselves the structural stability contained in mixtures comprising large aggregates. For this reason, surfaces of the former must be laid upon a reinforcing course (binder), to which the wearing surface is firmly bonded, and which adds a stabilizing element against the effect of those traffic forces which induce displacement. In considering such type of construction as sheet asphalt, modifications as to thickness may be based again upon the traffic conditions to be encountered. A pavement which is not subjected to traffic of an abrading character, but rather to traffic of motor trucks with rubber tires, requires less thickness of wearing surface and greater structural stability secured through the intermediate or binder course.

A further condition must be considered with reference to the character of motor driven vehicles, distinguishing between commercial vehicles and boulevard traffic, restricted to lighter but more swiftly-moving vehicles. Traffic of this latter character has a tendency, as indicated before, to produce lateral displacement, which results in the formation of parallel grooves or ruts in the direction of traffic. Such condition is best met where traffic of this kind is intense, by incorporating with the fine aggregate a percentage of stone, proportionate to the intensity of traffic, which serves to increase the internal resistance to flow under the rounded face of the tires. Mixtures made of large stone aggregate, i. e., the true asphaltic concretes, are more particularly adapted to this type of traffic.

Wearing Surfaces of Intermediate Type

Wearing surfaces of the intermediate type, containing varying amounts of small stone aggregates, have been laid very widely in recent years, the usual practice being to place such surfaces directly upon the foundation. Experience has shown that unless such surfaces or mixtures contain a prepondering amount of small stone, or approach true concrete (grit mixtures), they do not have stability upon the usual form of base to resist displacement of any but the most moderate traffic. This type of wearing surface has been generally laid 2 ins. thick. It is not well adapted to traffic, having a substantial abrading action for the reasons previously stated, nor does it possess the stability of itself to carry any volume of motor traffic without displacement.

Another type of surface containing intermediate aggregate are grit mixtures, comprising an aggregate predominating in small (usually ¼-in.) stone and constituting, with proper admixture of fine aggregate, a true concrete of miniature type. Such mixtures are decidedly more stable than Topeka mix, and are well adapted without a binder course to medium traffic of a mixed character.

Using Intermediate Binder Course to Give Stability for Heavy Traffic

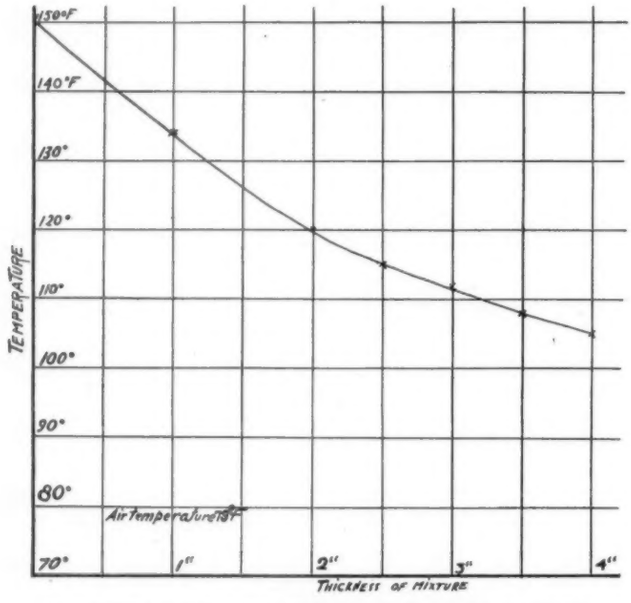
The lack of necessary stability for heavy traffic, characteristic of the Topeka mix (more properly, stone-filled sheet asphalt), can be corrected by the use of an intermediate binder course, which will add the necessary stability as it does in the case of sheet asphalt. Surfaces of this kind have been laid in the past few years to considerable extent throughout the Middle West. Such a combination of wearing surface and intermediate course possesses some advantage over other types wearing surface through increased stability against forward

displacement, as well as through increased stability against the grooving effect of swiftly-moving light vehicles.

It might be observed here that any surface laid upon a non-bituminous base of, say 2 ins. thickness, without an intermediate course, cannot be considered as possessing wearing surface to the full extent of its thickness. This is true for the reason that when reduced to a certain minimum of thickness, either by attrition or by displacement, it will break up through the shocks of traffic long before it is worn through. However, if laid upon a sufficient depth of intermediate course, a wearing surface of 1½ ins. will provide thickness ample for the most severe traffic.

Effect of Thickness of Bituminous Courses

As a general proposition, thickness of bituminous courses, both intermediate and wearing course, is effective against traffic forces in several ways. Increasing the thickness (1) decreases intensity per square inch of loads transmitted to the base, (2) decreases the intensity of those forces acting at the contact plane between base and intermediate course, tending toward displacement, (3) provides greater mass of shock-absorbing medium, (4) increase of thickness decreases the thermal effects which render mixtures less stable with ascending temperature. Demonstration of the above principles will be apparent from consideration of any simple diagram indicating the extension of a pressure cone through various thicknesses of surface to the base.



TEMPERATURE AT VARIOUS DEPTHS OF BITUMINOUS MIXTURE WITH A CONSTANT SURFACE TEMPERATURE OF 150 DEG. F. FOR 5 HOURS.

It is apparent, therefore, that the determination of the thickness of the intermediate and wearing courses becomes a very important factor in designing a pavement for a given intensity of traffic. From this may be deduced the proposition that for a given intensity of traffic a thick bituminous layer requires less depth of foundation than does a thin bituminous layer. Likewise, given a certain thickness of foundation, for example, 6 in. of Portland cement concrete, the demands of heavier traffic can be met advantageously by employing a thicker intermediate course to lessen the intensity of traffic forces transmitted to the base.

Effect of Seasonal Heat

Another point which has been most generally overlooked is the effect of seasonal heat upon bituminous mixtures. A bituminous mixture softened by heat becomes, as is well known, less stable, and more susceptible to those traffic forces which produce displacement. A thin surface will become heated through more quickly than will a thick surface. Some experiments undertaken to illustrate this proposition are given herewith, showing graphically temperature at various depths of bituminous mixture, the surface of which has been subjected to constant heat. This shows that a thick surface will be cooler at point of contact with its foundation than will be a thin surface, thereby becoming more stable, and in effect, *behaving as if it were laid at a lower penetration.* This reduction of thermal effect with increased thickness not only adds stability, but, it is apparent, also tends toward distribution of traffic shocks over greater areas of foundation.

Summary

To sum up, the most distinctive feature of modern traffic is the thrust of heavy motor-driven vehicles in producing displacement. Bituminous pavements must be designed to provide increased resistance to such displacement. The problem of providing a surface which will resist wear is comparatively simple, and the nature of traffic serves as a guide to the type best fitted for given conditions. Motor traffic will permit of less thickness of wearing surface, but, making more demands upon stability, necessitates greater thickness of binder, with corresponding care in composition. Binder course in its increased thickness may in fact be considered as a bituminous base transferring to its non-bituminous support the effect of traffic in diminished intensity.

When the wearing surface is of such type as requires no stabilizing course, the thickness should be increased in proportion to the intensity of traffic for reasons previously given.

Increasing the thickness of bituminous covering will to a large extent obviate the necessity of a heavier base which would otherwise be required by constantly heavier weight of traffic.

Essentials of Good Practice in the Construction of Concrete Roads

By Edwin K. Borchard, Engineer, Atlas Portland Cement Co., New York City

In any road the first and most important consideration is that of permanence. To be permanent the road must have sufficient strength to bear the heaviest traffic that will be imposed upon it. In addition to this, it must possess a surface which will resist abrasion and always be even and hard.

The Concrete Road

A concrete road is simply a continuous slab of concrete, composed of sand and stone, bound together in a monolithic mass by Portland cement. Owing to its strength, the concrete road slab distributes the highly concentrated load of vehicle wheels over a large area of the subgrade. Portland cement, the binding material in concrete roads, holds the sand and stone firmly and rigidly together, thus resisting abrasion and the dissipation of the fine particles of the surface. Concrete is impervious to water, thus making the concrete road an all-year-round road. Storms and alternate freezing and thawing have no effect upon concrete.

Low Tractive Effort Required

The even, hard surface of concrete roads permits heavy vehicles to be moved at the minimum of tractive effort. Experiments just completed by the California State Automobile Association demonstrated that the pull required to move a ton load over a concrete road was 27.6 lbs. A water-bound macadam road required 64.3 lbs., a gravel road 80 lbs. and a good dirt road 95 lbs. This means that concrete roads require only from one-half to one-fourth the power for hauling necessary on macadam or dirt roads.

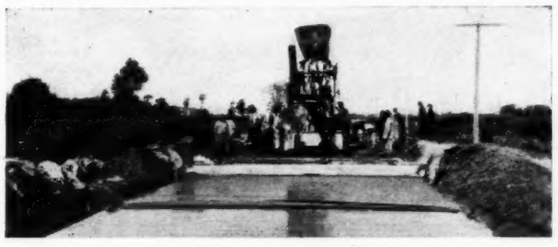
Low Crown

Since concrete roads are impervious, they need not be so highly crowned in the center to shed water. The average

crown of a 16-ft. road is only 2 in. at the center. This flat crown distributes traffic more uniformly over the entire road width, for the tendency of drivers is to keep to the center or top of a heavily crowned road, thus causing increased wear and even rutting at that point.

Maintenance

The low maintenance costs on concrete roads are phenomenal. The principal item of maintenance is the cleaning and filling with bitumen of the few cracks that may develop in the first two or three seasons. These cracks are mostly longitudinal, and, if properly attended to, in no way detract from



CONSTRUCTION OF LINCOLN HIGHWAY ON ELKHART-GOSHEN, IND., ROAD.

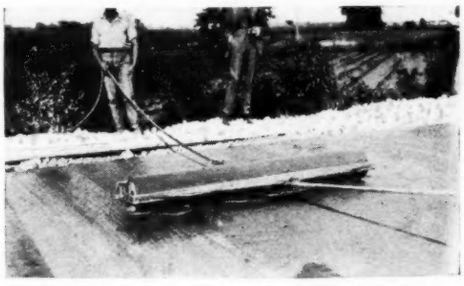
the durability of the road. Cracks are ordinarily caused by slight settling of the subgrade, due to improper preparation or drainage.

In the United States and Canada the amount of Portland cement concrete roads built has had a tremendous increase, as is shown in the following table:

Year	Sq. Yds.
Prior to 1909	799,390
1909	561,271
1910	1,313,449
1911	2,069,445
1912	5,295,447
1913	9,596,286
1914	14,815,034
1915	16,936,137
1916, approximately	26,000,000

Construction of Concrete Roads

Concrete roads are divided into two general types: One-course and two-course. One-course roads consist of a single thickness of concrete, usually 6 in. thick at sides and thickened at the center. This type is the one most used and is to be preferred. Where good, hard, durable sand and stone are not procurable locally it is sometimes the practice to construct the road in two courses—that is, a base course of the less durable aggregate and a thinner top course of a superior grade of aggregate shipped in from the nearest source. The base



ROLLER FINISHING A CONCRETE ROAD.

course and top course are laid practically at the same time, so that they will consolidate and bond together in a solid mass.

Subgrade

As in all types of roads, the preparation of the subgrade is an important consideration in building a concrete road. The grade should be established so as to obviate, as much as possible, any fills. Where fills must be made, the material should be deposited and compacted in thin layers. Where especially deep fills are necessary it is good practice, if possible, to allow the fill to settle through the winter before constructing the road upon it. Care must be exercised to remove all soft spots in the subgrade, so that it will be uniform in density and hence will not settle unevenly.

Drainage

The question of drainage must receive special attention. The methods to be employed are determined, of course, by the conditions peculiar to each road. In general, the open lateral ditches at each side of the road will suffice, if they are well built and maintained. Where more drainage than this must be provided, this consists of cross-drains connected with the side drains. Insufficient drainage exposes the road to danger of frost action, heaving and cracking.

Concrete Slab Thickness

The thickness of slab at the center line of the road is dependent upon the width of road. In a typical cross-section for a one-course road it should be noted that the thickness at edges, under ordinary conditions, is never less than 6 in.

Reinforcing

The practice of reinforcing concrete roads with heavy wire mesh or expanded steel is increasing. The reinforcing steel prevents the formation of large cracks due to uneven settling of the subgrade or insufficient drainage. The standard specifications for concrete roads require all roads over 20 ft. in width to be provided with a reinforcement weighing not less than 28 lbs. per 100 sq. ft. The reinforcing is placed 2 in. from the top of the road.

Joints and Joint Fillers

To allow for expansion and contraction of the concrete slab, due to temperature and moisture changes, it is necessary to provide transverse joints. These are usually located from 30 to 50 ft. apart and constitute a complete division in the slab. Two types of joints are employed, one protected at each side by vertical steel plates anchored to the concrete by lugs imbedded therein, the other type having these plates omitted. The use of protection plates is determined by the character of traffic to which the road is subjected. The function of the protection plates is to prevent spalling or wearing of the concrete at the joint. This is necessary where traffic is heavy.

CURING A GREEN CONCRETE ROAD BY THE PONDING METHOD.

With either protected or unprotected joints there must be used an elastic joint filler to prevent the entrance of water. This joint filler is usually ¼ in. in thickness and consists of a single strip of fiber matrix and bitumen. This strip is placed during construction and is about ½ in. wider than the depth of the pavement. This allows the filler to protrude above the upper surface, and it is then ironed down by traffic so that it extends over both of the slab edges, effectually protecting them.

Forms

The only forms required are the side forms of wood or steel plates (steel is preferable). These forms are staked to grade and carefully leveled before the concrete is placed. A transverse form is used at each joint location. To this is tied the joint filler. The concrete is deposited on each side of this

form and then the form is removed at once, leaving the filler in place, which thus divides the concrete through its entire depth.

Materials

The Portland cement is always specified as required to meet the Standard Specifications of the American Society for Testing Materials.

Extreme care is given to the selection of the fine and coarse aggregates (sand and stone), since upon these depend the wearing qualities of the concrete, for the cement acts as a binding material. Sand is defined as quartzite grains or other equally hard material, well graded from fine to coarse. The largest particles must pass a ¼-in. mesh screen and there must not be an undue amount of very fine particles. Sand for use in concrete roads must be of superior grade to that ordinarily employed in building work; it must not contain vegetable matter nor more than 3 per cent by weight of clay or loam.

Coarse aggregates consist of hard, durable crushed stone or pebbles. The largest pieces must not be over 2 in. in diameter, and all must be clean and free from dirt or loam. Bank-run gravel (sand and pebbles, naturally mixed just as it comes from the bank) must not be used.

Proportioning and Mixing the Concrete

The proportions now almost universally used for concrete are 1 part Portland cement, to 2 parts sand, to 3 parts crushed stone or pebbles. All materials are measured by volume and one bag of cement is considered as 1 cu. ft. The measuring of materials is very carefully done, as this is an absolute essential in securing a uniform quality of concrete.

The mixing of the concrete also should receive special care. The mixing must be done in a mechanical batch mixer and must continue for one full minute after all materials are in the drum. The consistence of concrete should be mushy wet—having a jelly-like appearance, in which no free water is visible.

Placing and Finishing Concrete

Before the fresh concrete is placed the surface of the subgrade should be well wet down, although not enough to show pools of standing water. This wetting prevents the absorption of the water from the fresh concrete. The concrete is then deposited to the full width of the road in successive batches. When reinforcement is used the concrete is placed within 2 in. of the full thickness, the reinforcement laid in place and the remaining 2 in. of the concrete at once deposited.

The fresh concrete is leveled and brought to the proper contour by means of a "template" consisting of a heavy board with bottom cut to shape. This template rests upon the side forms and is drawn forward over the fresh concrete, thus bringing the concrete to the proper crown. As the template moves forward it is also drawn back and forth, thus giving a sliding motion which serves to compact and even up the surface.

The finishing of the top surface is accomplished in several ways, depending upon conditions and the preference of the engineer in charge. The method first used and still most common is to float the surface lightly with a wooden float. The workman is supported on a "bridge" over the road, since no one must walk or stand in the fresh concrete. A wide, heavy belt, with handles at each end, is also used to finish the surface. It is drawn back and forth over the road. The latest method of finishing brought forward is rolling by means of a light sheet metal roller at the end of a long handle. With either of the last two methods it is usually necessary to do some floating in spots which cannot be easily reached, and at the joints. The main point in finishing is not to try for too smooth and slick a surface. A level, even surface is what is needed.

Protection and Curing of New Road

Fresh concrete must not be allowed to dry out too rapidly, and for this reason the road must be wet down and covered to protect it from winds and the direct rays of the sun. As soon as the concrete is hard enough to stand sprinkling without pitting, it is constantly kept wet until sufficiently further hardened to bear the protection material. This protection consists in most cases of a layer of earth 2 or 3 in. thick, kept constantly wet. Where earth for covering is not easily obtainable, the road is flooded with water to a slight depth, the water being kept in place by small earth dams on each side of the road.

The protection material must remain in place for at least ten days and the road not open to traffic for at least fourteen days—longer if the weather conditions are not favorable to the rapid hardening of concrete. Special precautions should be taken to bar off all traffic until the concrete has been allowed to attain the strength necessary to resist the load and abrasion it will have to bear.

Viable Roads Necessary Quickly for War Efficiency

By Lt. Col. James W. Howard, C. E., Consulting and Testing Engineer on Roads and Pavements, 1 Broadway, New York

A viable road means one which is in condition properly to fulfill its function of providing safe and rapid transit of vehicles. A constantly viable road is a road, including culverts and bridges, which is efficient for traffic at all times.

Europe for many years, and now our country, has realized that one of the greatest factors necessary for preparation and prosecution of modern warfare is constantly viable roads, necessary for many purposes, among them:

Uses of Military Roads

(a) To furnish through routes for auto trucks to deliver themselves from where manufactured to the point needed for use or for export.

(b) To enable auto trucks to carry large loads of machinery, ordnance, munitions, vast supplies for military and civil purposes, directly from where first loaded to where their loads are to be used or exported; and to do so quicker and cheaper, up to at least 300 miles, than to truck supplies to a local railroad station, reload on the railroad, go by railroad to another location and there reload on trucks and deliver the supplies to the exact location needed for use or export.

(c) Viable through routes for auto trucks relieve not only railroad transit congestion, but especially the great and increasing congestion at railroad termini.

(d) To eliminate terminus railroad freight congestion at large cities by having good local roads around and radiating from large cities and export points to surrounding small towns, which enables the railroad freight stations of many small towns to be used to handle freight thus kept away from centralized large city congestion; because those roads enable auto trucks to have many places to receive freight and deliver it directly to the exact locations needed in and near large cities or on the exact export dock. The local inadequate large freight stations in the large cities are thus relieved from congestion in Europe, and must be so relieved in America. Otherwise, disaster will follow the choking and delay now prevalent and increasing in many of our large cities. The congested termini of our largest cities, holding back cars loaded and idle on miles of side tracks outside the cities, is one of the reasons why coal, for example, so necessary for our productive efficiency, can not be delivered to the consumer, and why ships can not be built faster, because waiting for materials.

Slowness of transit and congestion of the necessary supplies has lost many wars. Viable routes, furnishing sure transit and prompt delivery, have won wars and are a tremendous necessity for us now.

Experience of past wars has established the military dictum that the war preparation and continued supply of soldiers,

materials and adjuncts have three factors: First and most important in quality and quantity; second, speed of preparation and delivery; third and last to be considered is cost—for the war must be won, cost what it may.

Need for Immediate Action

Viable roads are a military necessity and a vital adjunct. They must be of good quality, quickly supplied and maintained at whatever necessary cost. This can best be done by using existing good roads, linking them up with old roads to be quickly repaired and resurfaced; also, where absolutely necessary, some old bad and weak roads must be entirely rebuilt. The national, state and county officials should now quickly select the roads in many parts of most states necessary for war and pressing domestic supplies; inspect them; decide which must be repaired, resurfaced or entirely rebuilt, to carry heavy auto truck unit loads and many of them. Then work on these roads in many parts of most states must be quickly started and rapidly continued, by fixed bid price or percentage contracts, force account or day labor, including use of prisoners (properly paid) where possible.

Four General Groups of Military Roads

The roads needed for war productiveness and deliveries and for sustaining the people during the war, can be divided into four general groups, viz:

First—Roads which are in good condition and will bear the the heavy loads and resist the wear of traffic and weather, sufficiently to be kept with attention in constant viability.

Second—Roads which have firm foundations, but have their wearing surface layers so much out of repair in spots as to impede traffic and injure automobiles. Such roads can usually be quickest (speed being most important) and cheapest put in viable condition by repairing the spots with the same kinds of materials as now compose those roads.

Third—Roads which have firm foundations, but are in bad disrepair, and need new resurfacing over large sections or the whole road, and which can be quickest and economically (considering reduction of subsequent maintenance) made viable by resurfacing them. To do this it is cheapest and quickest where possible to use local materials, such as crushed stone, crushed hard slag, gravel, sand and sometimes ground mineral filler, mixed hot in various proportions to be as dense as possible, together with suitable bitumens, such as asphalt-cements. Spread the mixture and consolidate it with heavy steam or gasoline rollers to a finished depth of at least 2 ins. at all points. It may be necessary in some cases to even up, not cut down, the old road surface by any of the established methods and materials. In some cases it is best to fill depressions and even up the old macadam or other old road surface before resurfacing, by using crushed stone or its equivalent and pouring hot bitumen on it (penetration method). The asphalt concrete or other bituminous compound thus used for resurfacing, when rolled hard, can be cooled with water and thus at once opened to traffic as the work progresses. Work can be done on alternate sides of the road and traffic kept moving.

Fourth—Roads which have no firm base and which must be rebuilt, including grading, foundation and wearing surface layer. In such cases, where traffic can be safely blocked and sent by other roads for some time, it is slow but feasible to construct new roads with various materials needing time to use, such as Portland cement concrete foundations, brick, stone blocks, etc. In some cases where entire new roads must be built some time can be saved by constructing crushed stone or very coarse gravel foundations poured with suitable hot bituminous binders or cements.

While the foregoing is suggestive, local conditions will often compel other methods and materials to be used.

The hundreds of miles of viable roads now necessary for military efficiency will also furnish our country with a great asset and help in the post-war period, when they will be needed to increase economic efficiency then necessary to help pay the cost of war and re-establish and maintain prosperity.

Selecting Road Men in North Carolina

By D. H. Winslow, State Maintenance Engineer, North Carolina Highway Commission, Raleigh, N. C.

All states, counties and towns must pay for a trained road man or else they must develop such a man, if they expect to secure results on the highways. In any event, the taxpayers foot the bill. Many states are unable or unwilling to pay for trained men and are obliged to develop their own men. The success of the work depends on the men selected for the work, and the method of selection is of vital importance in building up an efficient organization. Many of the states are under civil service, but most of them are not. The civil service is more or less cumbersome, and many competent men could not pass the test for physical or other reasons.

The State of North Carolina has adopted a novel way of selecting its men that may prove of interest to others. A confidential file has been introduced which contains the following information relative to each applicant for a position: Name, age, position desired, salary expected, could report, employed at, P. O. address, 'phone, telegraph, application expires, and date of application.

It saves hours of work going over hundreds of applications to find a suitable man who will take a position at the salary that can be paid. By classifying the men at once, according to salary, the available men are known. The essential facts are shown and no time is wasted on men whose cards indicate they do not fall within the range of the position. All applications are destroyed on the date they expire. The list is therefore always up to date. The available men are notified and permitted to file any new information they care to submit. It is then an easy matter to examine the candidates and pick out the desirable man. No time is wasted with any other men. A man may have on file a card for several positions, if he so desires. A man may at any time recall his application and submit one that is up to date. The state thus secures a man at his own figures and at a price it is willing to pay for such service.

This list is of value to the state, the counties and the towns. It includes engineers, foremen, patrolmen and all classes, skilled and unskilled. No foolish or unnecessary questions are asked, and it is business from the start. Until there is an actual vacancy the man is not considered and none of his time wasted chasing up visionary prospects. No reference to politics, religion or place of birth is made and the man is selected on his merits alone. Practically all the men are selected after a personal interview, after the nature of the position and its requirements are fully known. The system has thus far given excellent results and the men feel they have been given a square deal. A man hired at his own figure for the special position he seeks is likely to be satisfied, and a satisfied workman usually shows results. A man may, if he elects, give a minimum and maximum salary on his application, thus covering a greater range of prospects. The system saves on clerical services and is a great saving of time in the office. It also saves on space by having on hand, in compact form, all information necessary to locate candidates on short notice when vacancies occur. It does away with long files of references, etc., until they are actually in demand. The selection of the right man is half the battle in solving the road problem, and anything that simplifies it should be given attention.

WATER WORKS MAINTENANCE AND OPERATION

How a Deficit of $2,000 Was Changed to a Surplus of $27,000 in One Year at the Waltham Water Works

By Bertram Brewer, City Engineer, Superintendent of Water Works and Sewers, Waltham, Mass.

The Waltham, Mass., water department, which does a gross business of about $100,000 annually, finished the year 1915 with a deficit of $2,428.53. At the end of 1916 this deficit was changed to a surplus of $27,243.54. How was it brought about? This is a live question, and the answer is an old-fashioned one—by strict honesty and *by the introduction of business-like methods in the maintenance of the department.*

Brief Description of Plant

Before explaining the changes that were introduced to effect this saving, a brief description of the plant is in order. It consists of two pumping stations, operated independently with horizontal, cross-compound, fly-wheel pumps of an actual average duty of 90 and 100 million ft. pounds, respectively. Each pump draws water from a large well constructed in an extensive area of water-bearing gravel, bordering a river which flows through the city. The average daily consumption is about 2,260,000 gal. and it costs between $14 and $15 per 1,000,000 gals. to deliver it into the reservoir. Of the two reservoirs, one, an open one of 10,000,000 gal. capacity, was partially abandoned about ten years ago, owing to organic growths resulting from the exposure of a ground water to the light, but is kept full as a standby supply in case of accident or unusual consumption. The other is a 2,000,000 gal. concrete covered reservoir or tank, 100 ft. in diameter and 40 ft. high on higher ground nearby. The mains in use are 60.55 miles in extent and serve a population of about 31,000 persons. The pipe is cast iron, of good quality, and well laid. There are about 4,300 services. They were all laid by the city and are mostly of cement lined, wrought iron pipe, though there was a period of ten years or so when the department fell from grace and put in galvanized iron. As Waltham water contains a considerable amount of free carbonic acid, brass and galvanized iron pipes are quickly corroded.

Meterage

About 65 percent of the services are metered. The average daily consumption per person is about 71 gals., as against 90 when metering was seriously begun. An average of about 10 percent of the services has been equipped with meters each year for the last three years, and this policy, no doubt, will be continued until all are metered. The meter force has an upstairs room in a brick building in a service yard on the railroad in the center of the city, used as headquarters for the different maintenance gangs. The work at the shop is in general charge of an assistant, who has particular charge of the stock and who acts as timekeeper to check up the time of the men, the stock used, and the diagrams showing measurements of and ties to all construction or repair work. The force at the shop includes, in addition to the meter division, the service division, and the construction and maintenance division. As the water and sewer departments are under one head, there is a fourth division, detailed to sewer work.

The pumping station force is under the control of a chief engineer, who is directly responsible for the upkeep and operation of the stations, and lives in a house adjoining one of them. These stations are both in the outskirts of the city, 1¼ to 1¾ miles away.

Water Rates

The charge for measured water is at the following rates per tenement:

Supplied with one faucet, a minimum charge of $5 for 2,500 cu. ft. or less; then 20 cts. per 100 cu. ft. up to 6,000; and 11 cts. per 100 for any amount in excess.

Supplied with one faucet and one closet, a minimum charge of $8 for 4,000 cu. ft. or less; then 20 cts. per 100 up to 6,000; and 11 cts. per 100 for any amount in excess.

Supplied with any number of fixtures, a minimum charge of $10 for 5,000 cu. ft. or less; then 20 cts. per 100 up to 6,000; and 11 cts. per 100 for any amount in excess.

There is no charge for the smaller meters. For 1½ in. and larger, there is an annual charge of 10 percent of the cost of installation. Fire service is free, and special fire connections are installed and maintained for sprinkler or private systems at the expense of the owner. The department pays no taxes of any sort and receives no money for fire protection, with the exception of an annual sum of $5 per hydrant. It does, however, receive payment for water furnished the various municipal departments throughout the city.

Services

The services are laid to the street line at the expense of the department; the owner pays at the rate of 40 cts., 45 cts., 50 cts. and 60 cts. per linear foot for 1-in., 1¼-in., 1½-in. and 2-in. services, respectively, inside his property, together with the actual cost of the shut-off inside his cellar wall.

Passing now to the question with which this article opened, relative to the sudden change from a business running behind financially to one that showed a big surplus, the writer will endeavor to indicate, in the brief space an article of this nature will permit, some of the principal changes that brought about this result in this particular case. Most of them are universal in their application.

Faulty Service Records Corrected

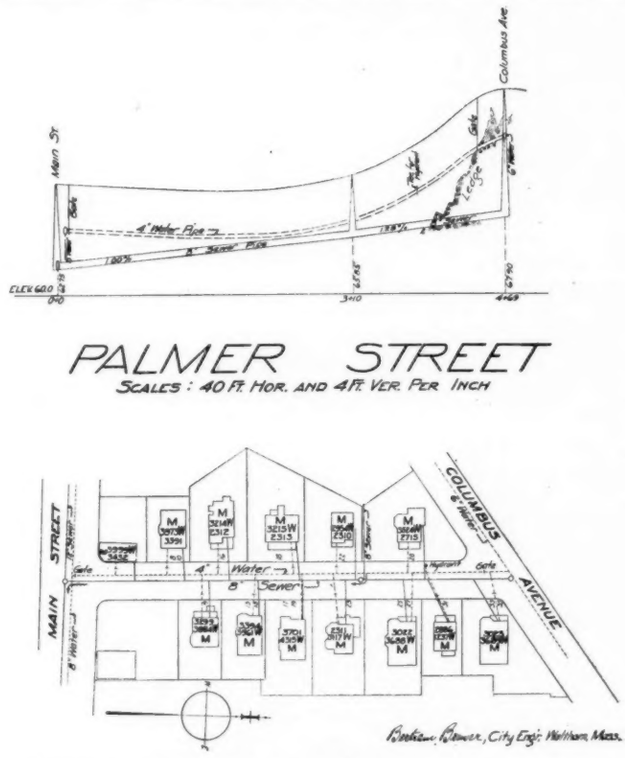
In the first place the records of the services were found to be very faulty. Many of the charges could not be explained. It was evident that there were omissions, yet there were no adequate plans to show where the error lay. Fortunately, the engineering department, which has for a long time had charge of the sewers, has kept complete plans and profiles of all the sewers by streets, with accurate location and plot of the house connections and the number of the connection allotted at the time of installation. The houses were also located and a beginning had been made toward placing the correct street number or numbers on each building. The plans are on sheets of tracing cloth, uniform in size, and are filed away in filing cases which open anywhere for the placing of a sheet in its proper alphabetical order. Work was begun immediately on plotting the water mains and services also, the appropriate service numbers were added, as well as a note to show if the service was metered, and, most important of all, every building was given the appropriate street number, something which will not change, no matter how many transfers of property occur. The books and bills have been gradually corrected as this work has proceeded, revenues have increased, and a large amount of time has been saved in clerical work thereby.

Less water has been pumped, a reduction in rates has been made, operating expenses have been reduced, yet the income has been somewhat increased because the charges have

been more correctly levied. A cut of a typical sheet is published with this article.

Department Thoroughly Organized

In the second place the department has been thoroughly organized so that each man knows better what is expected of him, necessary supplies are always at hand, and each division of the working force has every opportunity to become expert along its particular line. In a general way the organization has been indicated. It consists of an engineering division, a clerical division, a meter reading division, a pumping division, with a shop force divided into the various groups previously described. The work is so systematized that careful and complete records and locations are kept, any job finds the man best fitted to do it automatically and quickly, and careful record is made of the time occupied, material used and results, and this is preserved in the files for billing, cost accounting, and future reference. This is done on a series of printed forms or slips of uniform size, properly headed and identified by the appropriate street and service numbers. These forms have been very carefully planned and



TYPICAL SHEET OF WATER AND SEWER CONNECTION RECORDS, WALTHAM, MASS.

perfected with each new edition. It has been found that clearness, completeness and simplicity are great aids to efficiency. In every case the original notes made by the man in charge are preserved and filed. These records are a very important element in good organization. They have, among other things, proved a wonderful stimulus to the workmen. They learn to take considerable pride in keeping them, and interest in keeping the costs down and the grade of work high has been greatly augmented thereby. All this is only a way of applying the old principles of business efficiency, but it resulted the first year in the saving of many thousands of dollars. The writer's experience and observation lead him to believe that there is sore need of its application in many municipal departments.

Supplies

Then there is the question of supplies. It has been found very helpful to keep a brief record of all bills contracted under the appropriate dealer's name, alphabetically and chronologically arranged, in a loose-leaf book. This helps in acquainting the purchaser with the various dealers he trades with and the prices over a period of years. A study of this record often indicates how fast materials are used, the best time of year to buy, and the best opportunity for a good trade. In all the larger expenditures, like those for meters, coal, pipe, etc., the practice of asking for bids on the city's specifications has been adopted, with a great resulting saving.

Stockroom Established.

A stockroom was established early in the present regime. Three wooden cases were made by a local carpenter, each one containing 70 unit cubical divisions, 18x18x18-ins. Wooden boxes were purchased of a box maker to fit these units, the sizes of which vary from the large ones to take up the whole space to some as small as 18x4½x2-ins. for small meter parts. The sides of each division in the cases were grooved before erection so that horizontal partitions can be placed as needed to accommodate as many different size boxes in each 18-in. cube as a suitable distribution of the stock requires. A large quantity of material was thus discovered which could be used or repaired. Delays in searching for material are eliminated, and the men in charge of the stock can readily inventory the same and make frequent and intelligent reports as to the need of new supplies.

Water and Sewer Connections in Same Trench

Among other things which might be mentioned as saving in cost of departmental expenses is the practice of placing water and sewer connections in one trench by one gang of men, trained in the technique of both operations, the introduction of the paper plug and force pump method of cleaning services, prompt enforcement of the ordinances governing the collection of bills of delinquent water takers, as well as the elimination of incompetent or unnecessary workmen.

Changing Over from Flat to Meter Rate

The period of transition from fixture rate to meter rate is, to say the least, a trying one for any water department. It takes a vast amount of patience and educational propaganda on the part of the department to accomplish the change without a great deal of friction. As most of the difficulties that arise are due to misunderstanding, an intelligent recourse to the printing press and a series of notices as to proposed installations, precautionary measures to be taken by the owner, warnings concerning leaks and advice concerning their elimination, with information as to the exact time the new rates will go into effect, have ben found useful.

The Waltham authorities have stood behind this organization and have given the departemnt every opportunity to make good. The writer appreciates this backing and realizes how much backing of this sort means for better municipal government in America.

Municipal Jobs Must Be Made Attractive to Good Men

And this leads to a final word in concluding this brief account of the application of some well-known principles of efficiency and economy in one municipal department. Municipalities must rid themselves of dishonest and incompetent officials, but they must also make municipal jobs worth while for competent and honest men. Exceptional efficiency of management must receive consideration and encouragement. Unless there is sufficient intelligence in a community to grasp the significance and importance of superior work, there is no opportunity for a superior man. Honest administration must face a powerful element in every community which by every means, fair or foul, endeavors to secure special privileges and exemptions for itself at the expense of the other fellow.

The success of any scheme for the collective ownership, which looms large just now in the world, hinges on the human element. It would be well for every community to possess a local Good Government Association, constructive as well as destructive, as ready to back up good officials as to condemn

the bad. When the bulk of the people intelligently and conscientiously reach this state of mind, and back it up with their votes, every dollar of the public money will be carefully expended and rates will be reduced.

Measures Adopted to Curtail Water Consumption in the City of St. Louis

By Edward E. Wall, Water Commissioner, 312 City Hall, St. Louis, Mo.

No phase of water works maintenance and operation is of more vital interest than the restriction of water consumption. Large cities, such as Chicago, Philadelphia, St. Louis, Baltimore and Buffalo, where the great majority of consumers are supplied with water at flat rates, necessarily have large per capita consumption. Year after year these increase as new buildings with modern sanitary appliances for the housing of the population are built and the old houses abandoned. How to keep the consumption within reasonable limits or to reduce it to its proper quantity has been a problem to which the water works superintendent or engineer could always apply his ingenuity in his leisure moments, if he had any, but it has more often forced itself upon his attention because of its menace to efficient service.

Effective House-to-House Inspection in Boston

House-to-house inspection, coupled with rigid enforcement of regulations in regard to defective plumbing, has been exhaustively tried in many cities—notably in Boston some 35 years ago, when Dexter Brackett organized and operated what was probably the most efficient inspection force for the purpose of reducing leaks and waste that has been essayed in this country. In one year he succeeded in reducing the average daily per capita consumption from 91.5 gal. to 68. The thoroughness of the inspection gradually decreased during the years that followed, and the system was finally abandoned in 1895, partly on account of the expense, but principally because the opening of the new Metropolitan Water Works supplied an abundance of water. Then the consumption increased to such an extent that the Massachusetts legislature passed an act compelling the city of Boston to meter all connections within a stated number of years.

Examples of Water Waste

In St. Louis the water commissioner protested against the waste of water about 40 years ago, saying, "At the lowest estimate, I believe that 50 per cent. of the water pumped into the city is allowed to run back into the river without having been put to use."

Some years ago John Ericson, chief engineer of the Chicago water works, estimated that probably 70 per cent. of the water pumped into the mains was wasted. At that time the daily per capita consumption was about 200 gals.

Pitometer Surveys and District Inspection

Pitometer surveys in various cities have uncovered great losses from underground leakage. District inspection by the Deacon system in several English cities brought about large reductions in consumption at surprisingly low expenditures.

Both of these methods have been tried in St. Louis, but the systematic house-to-house inspections for leaks and waste, carried on daily, year in and year out, have contributed more than anything else to keep the average daily per capita consumption below that of most of our larger cities.

Pitometer surveys of nine districts in different parts of the city showed no underground losses of consequence, even in localities where mains had been in service 50 years or more. District inspection, after the manner of the Deacon system, did not produce results encouraging enough to follow it up continuously or apply it to large areas of the city.

Work of the Inspection Branch

In the organization of the Water Division of St. Louis is the Inspection Branch of the Distribution Section. This branch consists of a force of 37 men, including the superintendent, 30 of whom are inspectors, who are assigned to 12 districts into which the city is divided. These inspectors are continuously on their respective districts, examining all premises for evidences of leaks or waste. Over 200,000 inspections are made per year, and more than 13,000 leaks reported, of which about 90 per cent. are repaired by owners upon being notified. About 1,500 premises are annually shut off on account of failure to make prompt repairs.

The permanent effect of such inspection lies in the thorough and continuous work done. It is evident that any cessation in vigilance would in a short time result in an accumulation of leaks and increased carelessness as to waste by all classes of consumers.

Hot and Cold Weather Water Consumption

The average daily per capita consumption of 133 gals. for the year 1917 for St. Louis is unquestionably much higher than it should be, and in a way is misleading, because the average must take into account the abnormal waste during cold weather when faucets are allowed to run to prevent house pipes from freezing, and in the summer when excessive lawn sprinkling is practiced during hot, dry weather, both of which conditions often tax the full capacity of the works. For example: The maximum daily consumption last summer in St. Louis reached 134,600,000 gals. and this winter 154,400,000 gals., while the normal daily consumption during moderate weather was about 92,000,000 gals., or 120 gals. per capita.

Efforts to Lower Winter Maximum

Efforts to stop the waste of water during periods of cold weather by night inspections and by shutting off the water at the curb-box, without notice, at all places where water was found running after midnight, were more productive of trouble than of saving water. Practically all offenders indignantly denied wasting water, and many were not only willing to make affidavits to that effect, but also offered character witnesses to testify to their veracity. Besides, by the time a night inspection force was properly organized and broken in to the work, the cold spell would come to an end, and the practice of letting the water run was stopped. Thus, before the expected good results could be obtained, the necessity for night inspection ceased to exist, and when the next spell of severe weather came along, the people, who notoriously have short memories, resumed their old habits of opening their faucets to protect their plumbing.

Efforts to Lower Summer Maximum

The same results in effect attended all efforts to punish offenders who wantonly wasted water through hose connections in summer. The same violent denials and protests brought an avalanche of trouble to department headquarters, and the right to use an unlimited quantity of water for the purposes of health, cleanliness, and for beautifying the city in keeping up the lawns and green spots, was vehemently upheld by some of the local newspapers. The water division was coolly advised to buy more pumps and enlarge their mains, as though that were a mere matter of minor detail that could be arranged for at an hour's notice.

Meterage Only Way to Lower Consumption

Such experiences as these are common to all water works engineers and managers—and lead to the conclusion that no logic can convince the unthinking public that it is more economical voluntarily to restrict themselves to a temperate use of water, even though their current bills are not reduced, than to indulge in reckless waste, which must later be directly or indirectly expensive to them. The only way to bring home to them in a way which they can feel and understand the fact that it costs money to supply water, is to sell them water by measurement, so that he who wastes, pays.

St. Louis' Attitude on Meters

When the writer, in 1911, proposed the general metering of the city, by installing 17,500 meters each year for five years, the department to furnish and install them without cost to the individual, it raised such a storm of protest from all quarters that one would imagine that it was contemplated to deprive them of one of the sacred rights assured by the Constitution of the United States.

It was in vain that figures were submitted, showing that the saving in expenditures for increasing the capacity of the works would many times pay for the cost of meters, and that the capacity of the present works would be enabled to supply the city at least ten years longer. No one questioned the accuracy of these statements, but the majority of the people and all the newspapers continued their vociferous objections to meters, facts or no facts. Since that date the opposition has moderated to some extent, but it is still evident that the time has not arrived for an adoption of the policy of universal metering.

During the seven years from 1911 to 1918, there has been expended over $4,500,000 in carrying out a general plan to bring the existing system to the utmost capacity possible. To complete the entire system as originally contemplated, a further expenditure of over $2,000,000 will be required. It is estimated that the city can be supplied from these works until 1926, at the present rate of increasing consumption, and under the present policy of the practically unrestricted use of water by flat rate consumers.

What Meterage Would Mean to St. Louis

Should the city agree to the general policy of universal metering, and provide for the installation of not less than 25,000 meters annually, at the same time enforcing reasonable restrictions for flat rate consumers during the period of changing over, it is certain that the present water works would furnish an ample supply at least until 1936.

It seems practically impossible to convince the public and municipal officers (who generally take their cue from public sentiment) of the wisdom of looking well ahead, especially as to the quality and quantity of water supply.

Most cities have at one time or another gone through the experience of having been rudely aroused from their indifference and inattention to the gradually increasing inadequacy of the water supply by its sudden scarcity or total failure. In such cases they are amazed to realize how long they have been trusting to good fortune without meeting disaster.

Then often follows unwise expenditures on hurried plans for relief from a situation that could never have arisen under proper management.

The capable and conscientious engineer or superintendent of a water works always endeavors to plan and provide for the future consumption of his community in ample time to prevent any serious shortage of water. Among the records of most of the larger water works will probably be found reports, more or less elaborate, covering local conditions, estimating future demands and proposing extensions and improvements sufficient to provide a generous water supply for years to come. These reports, no matter how pertinent to the case, or how thoroughly the conditions have been studied and reviewed, scarcely excite more than a passing comment from the press, and are then filed with the rest of the accumulated documents recording futile human endeavor.

DRAINAGE AND IRRIGATION

Features of Overhead Irrigation Systems in Small Gardens Within Reach of City Water Works Plants

By W. H. Coles, President of the Skinner Irrigation Company, Troy, Ohio

The importance of overhead irrigation has been recognized for a number of years. However, it has been only within the last few years that its relation to small gardens within the reach of municipal water works plants has come to be appreciated. This is now commanding the attention of power companies and of companies who are selling water. Its development within the next five years promises to be one of the most productive sources of income, both to the service companies and to their engineers. The story of the development of overhead irrigation provides a background which emphasizes its possibilities as linked with the future of water service companies.

Origin of Overhead Methods

Some ten years ago the overhead methods of watering first came into prominence. Systems were simultaneously developed by a large florist in Chicago, by Mr. Skinner in Ohio and also by a grower in Florida. A recent U. S. Department of Agriculture bulletin, No. 495, issued on spray irrigation, says that the development of this stationary overhead spray system marked the beginning of rapid progress in spray irrigation for commercial crops.

It was soon found that these systems were conflicting and that each possessed merit and they were united some six or seven years ago into what is known as the Skinner System of irrigation.

Elements of an Installation

If the reader were to notice, he would find in practically every vegetable growing center in the United States numerous fields equipped with long pipes, fifty feet apart, parallel to each other and parallel to the ground. These pipes are fitted with nozzles inserted every 3 feet, the nozzles being placed in a row. A series of parallel streams from each pipe is the result. These streams cover a strip from 6 to 10 ft. in width and the full length of the pipe. A space 50 ft. in width is watered by turning the line occasionally on its axis. The sprays are of such a size and the nozzles of such a construction as to conform to the principles of watering which secure the most successful results. The system is exceedingly simple. It is practically fool-proof and has been accepted as indispensable in almost every vegetable growing center throughout this country and in many other parts of the world.

Results Obtained

Remarkable results have been obtained from the use of this overhead irrigation. In the official organ of the Chamber of Commerce of the State of New Jersey, Volume 4, No. 8, there was an article by C. F. Seabrook, who has 190 acres of this system and operates one of the most modern vegetable growing farms in this country. He gives the following results from the use of the Skinner System:

Six hundred and forty bushels of potatoes were grown under the Skinner System of Irrigation, whereas our average without irrigation was about 175 bushels per acre.

Beets for the cannery with tops yield about 32 tons per acre under irrigation. Without irrigation, we produced one-tenth of this amount. Celery under irrigation yields 600

crates to the acre, as compared with 200 crates to the unirrigated acre. Irrigation has increased the onion yield to an average of 1,200 bushels to the acre, as compared with 300 bushels to the unirrigated acre. Lettuce is doubled by irrigation. The average strawberry yield through the United States is 2,000 quarts to the acre. The average yield under our irrigation system is from 8,500 to 10,000 quarts to the acre. Considering both the quality and quantity, the yield from an unirrigated acre as compared with the yield of an irrigated acre, the ratio represented is about one to five.

Automatic Operation

From these hand-operated systems more highly perfected equipment was developed. Devices are installed whereby the lines are oscillated automatically by water power and in unison, this being done in blocks of one acre, two acres or ten acres operated as a unit. From the simple hand-operated lines to the more complete and highly perfected automatic irrigation systems, this method of watering is adapted to every condition and to every need. The most highly perfected equipment provides for the first time a means whereby a garden or a field may be watered automatically, uniformly and correctly.

Profitable Relation Between Public Water Supply Works and Overhead Irrigation for Gardens

A great many power companies have interested themselves in the spread of this overhead irrigation. They work with growers, supplying power for pumping and in many localities the relation is not only very intimate but profitable for both the company and the grower. Some companies equip land and sell it out on terms, supplying the irrigation system and selling power or water as the case may be.

The results which were so clearly evident from this method of watering soon began to appeal to the small garden owner, who desired in a minor way the benefits which the commercial growers were so clearly demonstrating. The manufacturers of the Skinner System recognized this demand, developed and put on the market sectional sprinkling lines, which are sold by the foot. They are so designed as to go together automatically, and a careless grower cannot put them together in any but the correct manner. The war garden enthusiasm of last year emphasized the fact that growing is an art and that gardens which were not properly handled were unproductive. The owners began to appreciate the burden of standing with a hose and supplying their gardens with moisture.

As a result, the interest in irrigation systems for these small gardens has very considerably increased. The water works companies are recognizing this interest and are equipping themselves to handle the demand. The engineers and experts with these companies are informing themeslves of the requirements of this new line of work, and in many cases they have not only been of service to the companies with which they are associated, but they also have been called in consultation in the erection of irrigation sytsems by commercial growers on a larger scale, even though they be out of the tation in the erection of irrigation systems by commercial

The writer of this article would very emphatically deny the charge that he is an old man, but he can remember in the little town in which he lives the time when the use of a public water supply was somewhat of a rarity. It was the occasional man who had the water works piped into his house. It is now a rarity to find a residence which is not connected to the water works system. In the early days little attempt was made to keep the lawn green. The watering of the street and the watering of a few flower beds was the full use to which the water was put. Now a burned-up lawn in any summer is considered a sign of shiftlessness or indifference. The same has been true of the use of water in bath rooms, as all engineers know.

Use of Public Water Supply for Irrigation Purposes in Its Infancy

Comparatively few engineers, however, recognize that the new use of water is in its infancy. In Los Angeles, Cal., there are more than one hundred acres of the parks watered by this stationary system of irrigation, and every modern residence has some means of keeping its lawn green. The average reader of this article will be surprised to find how many similar installations exist in the eastern half of the United States, many of them running into tnousands of dollars in cost. The back yard gardens of even humble owners are being equipped more and more with a permanent stationary system of watering, which eliminates the drudgery and produces full and luxurious crops.

This use of water is pressing itself on the water service companies. Not only will they find in it a profitable source of revenue, but they will soon discover that they are subject to just criticism if they do not prepare themselves to meet and to serve this demand. Within the next few years the remarkable development of this overhead watering in the commercial industry will be repeated in those lines of growing which are within the reach and which furnish an unanticipated use of water which is not as yet fully recognized.

WATER PURIFICATION AND SEWAGE TREATMENT

Some Characteristic Design Features of the Northeast Sewage Treatment Works at Philadelphia

By W. L. Stevenson, Assistant Engineer in Charge, Sewage Disposal Division, Bureau of Surveys, Philadelphia, Pa.

Work is now in progress toward the construction of 32 Imhoff tanks and their appurtenant sludge drying beds for the treatment of sewage to be collected by the intercepting sewers of the Frankford Creek drainage area in the city of Philadelphia.

This work constitutes the first step toward carrying out the comprehensive plan for the collection, treatment and disposal of the sewage of Philadelphia, as recommended in the Report of the Bureau of Surveys issued in 1915.

The present tank installation is designed to care for the sewage of 300,000 people, amounting to 60,000,000 gals. a day average flow at 3 hours' retention. It will form an integral part of the complete Northeast Works as designed for estimated conditions in the year 1950.

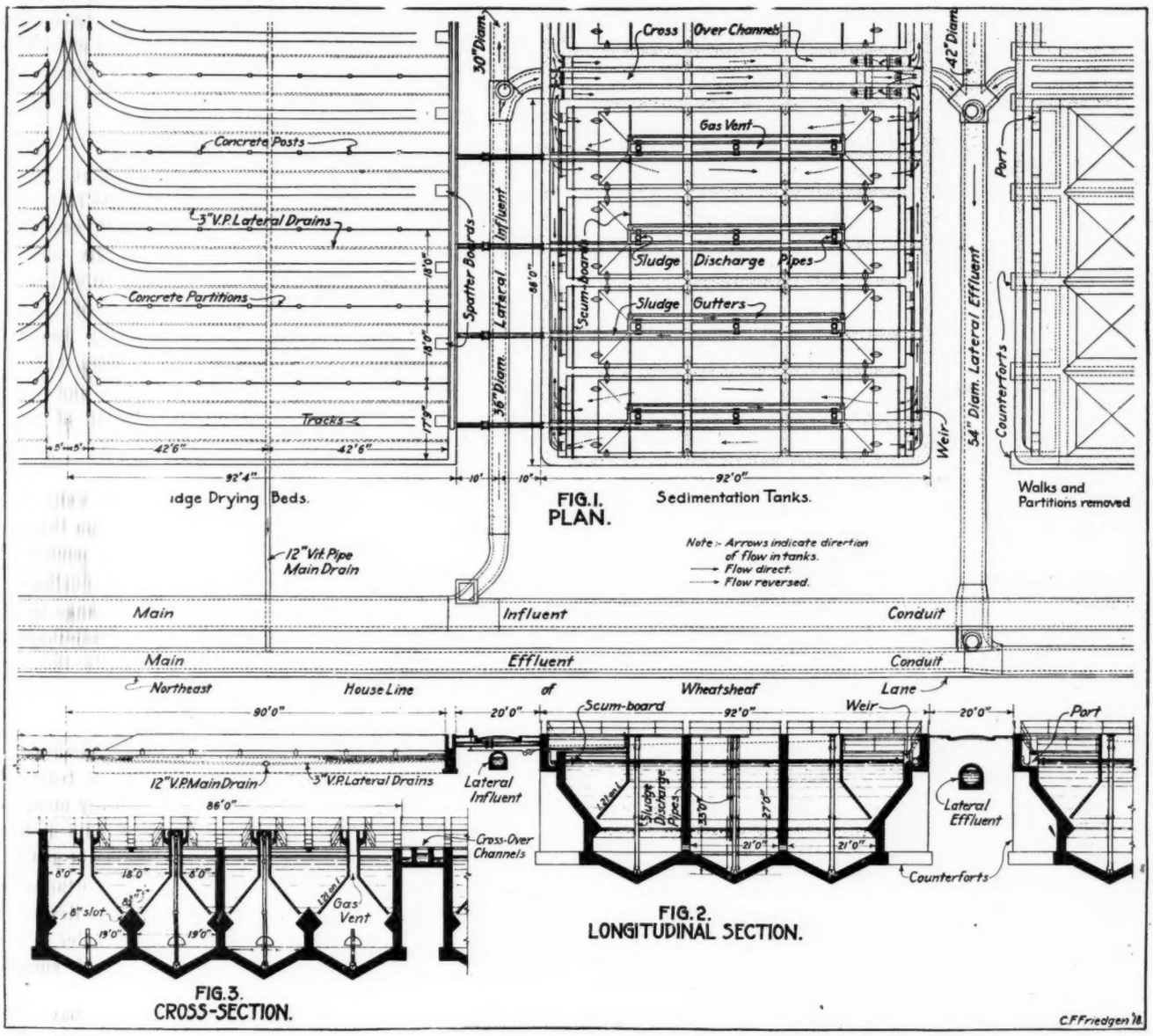
The Settling Tanks

The tanks are arranged in 4 batteries of 8 tanks each, beside which are sludge drying beds of the same overall length, divided into 20 units for the sake of elasticity in operation. The tanks are of rectangular, horizontal flow type, constructed of reinforced concrete, each 40 ft. wide, 80 ft. long and 27 ft. from the surface of the water to the bottom of the sludge hoppers, of which there are six in each tank.

From a main influent conduit, laterals will convey the crude sewage to cross-over channels at the middle of each four tanks of a battery in order to provide for reversal of flow. The tanks are entirely symmetrical, so that either end may become the inlet. From the cross-over channels the sewage will be conveyed to the tanks by open channels, which

Scumboards are provided 18 ins. and 15 ft. 6 ins. from each end of the tanks.

The sedimentation compartment is separated from the sludge digestion compartment by reinforced concrete partitions with slopes of 1.2 on 1, making slots 8 ins. wide with 8⅜ ins. overlap from projections on the side and end walls.



SOME DESIGN DETAILS OF THE NORTHEAST SEWAGE TREATMENT WORKS IN PHILADELPHIA, PA.

decrease in width from 24 ins. to 15 ins., so as to maintain proper velocities as the quantity of sewage flowing in them decreases.

Tank Details

The ends of the tanks are provided with two adjustable metal weirs, each 10 ft. long, and also with two ports, each 24 ins. wide, equipped with metal sliding gates to regulate their opening. At the inlet end the ports will be open from the bottom of the channel, but at the outlet end they will be closed. Sewage will therefore be admittd to the tanks over the weirs to carry surface materials and under the ports to admit to the tank the heavier solids carried along the inlet channel near or on the bottom. By these means, it is expected to prevent any deposits in the inlet channels from carrying crude sewage.

In each tank above the sloping partitions there are two gas vents, each 51 ft. long and 24 ins. wide.

Lifting Sludge with Compressed Air

The general elevation of the site of these works is at elevation +10 and the water surface in the tanks is to be +4. In order to avoid the impression of the finished works being depressed, it was decided to carry the side walls and gas vents to elevation +10. This decision, combined with the fact that a gravity flow of sludge from the tanks would have placed the sludge beds at such a low elevation that ground water would have prevented free draining, made it desirable that the sludge beds be placed at an elevation of about +4, which requires that the sludge must be mechanically raised from the hoppers.

To carry out this policy a vertical sludge pipe is provided

for each hopper. Its upper end is a cross provided with valves at the sides and a cap at the top.

Compressed air will be introduced into the sludge pipe to raise the sludge by the principle of the air-lift pump. Water pipes will supply rinsing water in the bottoms of the hoppers and also at the top of the sludge pipe so as to fill it completely with clean water after sludge has been drawn.

Sludge Gutters

The valved sides of the crosses of the sludge pipes will discharge into gutters 12 ins. wide and 18 ins. deep at the shallowest point formed in the side of the gas vent. One gutter will be graded to carry the air-lifted sludge to the sludge drying beds. The other gutter will extend only the length of the gas vent and be graded in the contrary direction.

In addition to carrying sludge to the drying beds, these gutters can be used to transfer sludge from one hopper to another and so avoid the stagnation which is antagonistic to good digestion.

Furthermore, by the use of stop planks placed on one side of the gas vent, it will be possible in case that foaming occurs to convey such floating sludge to the drying beds instead of allowing it to flow over the settling sewage, as has occurred elsewhere.

Cross walks with guard rails are provided over the tanks connected with the end and side walls and gas vents, so that the operators can reach every part of the tanks in safety and comfort.

Sludge Drying Beds

Each sludge drying bed is 18 ft. wide and 85 ft. long. They are separated by precast concrete slabs set in posts drained by two lines of 3-in. tile leading to a 12-in. main underdrain, which in turn discharges into the main effluent conduit of the works.

A 24-in. gauge industrial track is laid down the center of each bed leading to a main track between the batteries of beds. A motor-driven engine will haul the small cars to convey the air-dried sludge to a place of disposal.

The surface of the drying beds is a 2-in. layer of mortar sand resting upon layers of graded gravel increasing in size from 1-16 in. to 1½ in.

Seeding and Planting

Upon completion of the works, it is intended to plant trees, beds of shrubs and flowering plants in such a way as to make the site attractive, as has been successfully carried out at the Pennypack Creek Sewage Treatment Works, which the city has operated since 1912, and which policy has not only caused the operators to take pride in the plant, but has shown the many citizens and other visitors that a sewage treatment plant can be kept clean and be neat and attractive.

Personnel

These works were designed under the direction of Mr. George E. Datesman, Director, Department of Public Works, by the Bureau of Surveys, of which Mr. Chester E. Albright is Chief Engineer, and are being constructed under a unit price contract with a limit of $1,025,000 by the Philadelphia Subway Construction Company.

Results of the Chlorination of Public Water Supplies in Michigan

By Edward D. Rich, State Sanitary Engineer and Earl L. Waterman.

The operation of water chlorination plants in Michigan has been under general control of the State Board of Health since January 1, 1916. There are 23 municipalities and private companies in the state which use chlorination as the only treatment for public water supplies. A brief summary of the data furnished by the reports during the year ending June 30, 1917, is given below. This information is of particular value in pointing out conditions under which chlorination is successful, as well as those where its limitations have shown that it is not adaptable. It is from Engineering Bulletin No. 10 of the Michigan State Board of Health.

Alpena

The water was treated with hypochlorite from February, 1913, to October, 1915, and with liquid chlorine since. Water is obtained from Thunder Bay (Lake Huron) and is subject to frequent pollution. Monthly reports during 1916 show that the average pumpage is 2,061,000 gal. per day. Liquid chlorine is applied in amounts varying from 2 to 6 lbs. per million gallons. Organic matter in the raw water as indicated by the oxygen consumed tests is often very high. Laboratory control and careful supervision of the chlorinating plant have not sufficed to produce a safe palatable water at all times. Our information indicates that other treatment of the water is necessary.

Ann Arbor

The city has two sources of supply, deep wells and Huron River. River water was treated with hypochlorite from 1912 to June 15, 1915, when a change to liquid chlorine was made. The average pumpage at this plant is 2,800,000 gals. per day. Eight to 10 lbs. of liquid chlorine are used per million gallons of water. Laboratory tests show the presence of organic matter in considerable amounts, unusually high bacterial counts at 37° in both the raw and treated waters, and the chlorination treatment is not entirely satisfactory and points out the necessity of adopting some other method of water purification.

Battle Creek

Most of the supply comes from deep flowing wells with an auxiliary supply from Goguac Lake. Water from the lake is treated with liquid chlorine at a rate of one pound per million gallons. Hypochlorite of lime was used during the period of March, 1912, to April, 1914, when the change to liquid chlorine was made. Results of laboratory examinations of untreated and treated water seem to indicate that the chlorination is successful.

Bay City

There are two entirely separate water supply systems, East Side and West Side. The East Side supply is taken from two sources, Saginaw Bay and Saginaw River. The daily pumpage at this station averages 4,500,000 gals. Hypochlorite of lime was used for several years prior to the installation of a liquid chlorine treatment plant in April, 1916. Liquid chlorine is applied at the rates of 3 to 4 lbs. per million gallons. Results of daily laboratory tests show that the East Side water is seriously polluted; liquid chlorine treatment is not successful.

The West Side supply is drawn from Saginaw Bay. The daily pumpage from this source averages 2,300,000 gals. This water is subject to contamination to a degree which varies with wind conditions on Saginaw Bay. Liquid chlorine treatment was begun in April, 1916, the rate of application being 1 to 3 lbs per million gallons. Laboratory examinations indicate that this treatment cannot meet the changing conditions of the raw water in such a way as to render the water always safe and fit for domestic purposes. Preliminary plans for a filtration plant at Bay City have been prepared.

Detroit

The municipal supply is taken from the upper part of the Detroit River. It was treated with hypochlorite from April, 1913, to March, 1916, and with liquid chlorine since January, 1916. The daily pumpage averages 130,000,000 gals. The water is treated with 1.5 to 3 lbs. of liquid chlorine per million gallons. Laboratory examinations show that chlorination produces good results. This plant has excellent supervision which undoubtedly contributes largely to its successful operation.

East Grand Rapids

The municipal water supply is taken from Reed's Lake, the average daily amount pumped during the last ten months of 1916 was 63,400 gals. Liquid chlorine has been used since June, 1915—the average amount used during 1916 was 4.96 lbs. per million gallons. Weekly tests on both the raw and treated water show a rather high organic content, low bacterial counts per cubic centimeter, and only rare instances of the presence of B. Coli. Chlorination of the public water supply in East Grand Rapids results in furnishing to the consumers a safe, potable water.

Gladstone

The municipal water supply is taken from Little Bay de Noc (Lake Michigan). Hypochlorite treatment has been used since December, 1913. The average daily pumpage during 1916 was 342,000 gals. Hypochlorite of lime was used in amounts varying from 12 to 25 lbs. per million gallons. The solution is pumped into the raw water through small proportional pumps attached to the main pumping units. This insures a constant rate of dose, but does not allow much flexibility in the amount of the solution to be applied. It is interesting to note that owing to the difficulty in securing bleach, no treatment was applied between January 25, and April 28, 1916. Tests made at the State Laboratory at Houghton, indicate that closer supervision and control is necessary to insure the successful operation of this chlorination plant.

Highland Park

The supply from Lake St. Clair has been treated with liquid chlorine since June, 1915. The average daily quantity of water pumped during 1916 was 7,000,000 gals. Liquid chlorine was applied at a rate of 1 to 3 lbs. per million gallons. Tests show that this source of water supply is subject to contamination particularly during the summer months, and that at this period the chlorination did not produce a uniformly satisfactory drinking water. Plans for a filtration plant are being made.

Ludington

The municipal water supply is taken from Lake Michigan, and is treated with hypochlorite of lime. This treatment was begun in March, 1912. The 1916 monthly reports show that the average pumpage was 1,250,000 gals. and that the hypochlorite was applied at an average rate of 6 lbs. per million gallons. Laboratory tests were made irregularly until December 1st. when daily analyses of the raw and treated water were started. The results of the analyses made during December show that the chlorination of the water resulted in a 98 per cent reduction in the number of organisms growing at 37°C. B. Coli was not present in either the raw or treated waters.

Marine City

Water for the municipal supply is taken from the St. Clair River, the average pumpage being about 1,250,000 gals. Hypochlorite treatment was begun in December, 1913. During 1916, the rate of application of the bleach was about 6 lbs. per million gallons. No laboratory tests are available on which to base an opinion as to the efficiency of the treatment.

Menominee

The supply is taken from Green Bay. Hypochlorite treatment was used from March, 1910, to October, 1916, and liquid chlorine since. The average daily pumpage is approximately one million gallons. Laboratory reports show that this source of supply is subject to contamination. A filtration plant has just been completed. Liquid chlorine will be used as a supplementary treatment by the new plant.

Monroe

This plant is owned by the Monroe Water Co., and the supply comes from Lake Erie. The average daily pumpage is 1,200,000 gals. Liquid chlorine treatment is used at rates varying from 3 to 8 lbs. per million gallons. The reports for 1916 show that this water does not readily yield to chlorine treatment. There were 66 bacteriological examinations of the treated water during 1916; 31 tests or 47 per cent show B. Coli present in 10 c. c. quantities of water; 24 tests or 36 per cent show B. Coli in 1 c. c. quantities of the treated water. We are informed that there are many complaints about the tastes and odors in the treated water. The 1916 reports show that chlorination is not a success and point to the necessity of adopting other methods of water purification for this plant.

Negaunee

The municipal water supply is taken from Teal Lake and has been treated with hypochlorite since January, 1914. For 1916, the average daily pumpage was 1,300,000 gals. and the hypochlorite treatment was at a rate of 1 to 4 lbs. per million gallons. Laboratory tests are made regularly and indicate that chlorination of Teal Lake water is an effective method of treatment.

Port Huron

The municipal supply is pumped from St. Clair River and treated with hypochlorite of lime at an average rate of 7½ lbs. per million gallons. The average pumpage during 1916 was 9,500,000 gals. per day. The hypochlorite solution is fed through proportional pumps. A municipal laboratory has been installed but was not ready until Dec. 1, 1916. Tests made during December show that the water was low in organic matter and that the chlorination treatment was successful from a bacteriological standpoint. Liquid chlorine is to be substituted for the hypochlorite method.

South Haven

The municipal supply is taken from Lake Michigan. The Black River empties into the lake just north of the water works plant and under certain conditions the river water undoubtedly carries pollution out to the water intake. The continued prevalence of typhoid fever in South Haven led to the adoption of chlorination treatment for the water supply in April, 1912. A remarkable reduction in the number of cases of typhoid fever has resulted.

Excellent laboratory control and careful supervision of the chlorination plant have given very good results. There are a few times during the year when contamination reaches the water intake—on these occasions the production of a satisfactory effluent by chlorination is very difficult.

St. Clair.

The municipal supply is taken from St. Clair River. Hypochlorite of lime treatment has been used since May, 1913. The average daily pumpage during 1916 was 738,800 gals. and the application of hypochlorite was at rates of 5 to 8 lbs. per million gallons. There were no regular laboratory tests during 1916 and we have no data on which to base an opinion as to the efficiency of the chlorination treatment at St. Clair.

Wyandotte

The municipal water supply pumped from the Detroit River below the city and treated with hypochlorite of lime. The average daily pumpage during 1916 was 1,866,500 gals. Hypochlorite is applied at rates varying from 15 to 20 lbs. per million gallons. Daily laboratory examinations of both the raw and treated water have been made since July 10, 1916. The results of these tests are most conclusive in pointing out the fact that the Wyandotte water supply cannot be rendered safe and palatable by the process of chlorination. We are informed that very frequently the odor and taste in the treated water are so strong that the water is wholly unfit for any domestic use, furthermore, the water is unsafe from a bacterial standpoint, approximately 99 per cent of the time.

St. Joseph

The municipal water supply is pumped from Lake Michigan. Hypochlorite treatment, begun in July, 1912, was changed to liquid chlorine in April, 1916. The average daily pumpage for 1916 was 778,300 gals. Since the installation of a liquid chlorine machine, liquid chlorine has been used at an average

rate of 1.5 lbs. per million gallons. A municipal laboratory was installed in April, 1916, and since that time complete reports of daily tests of the water have been submitted for the St. Joseph city water.

Traverse City

The municipal supply is pumped from Grand Traverse Bay (Lake Michigan). Hypochlorite treatment was begun in July, 1912, and continued irregularly until May, 1916, when a liquid chlorine machine was installed. A municipal laboratory is provided and daily tests were made during the last half of the year. The results show that the chlorination treatment is satisfactory.

FROM WORKERS IN FIELD AND OFFICE

Facilitating Motor Freight Haulage

The Editor of MUNICIPAL ENGINEERING:

Sir—"From Detroit to Berlin," an unusually suggestive sign it was, stretched across one of the army trucks which recently made the trip from the factory in Detroit to the point of embarkation.

The army recognizes the dire necessity of easily passable, permanent roads, which are becoming as important a medium of transportation as the railroad—the motor truck as the locomotive. France has come to recognize the difference between temporary roads and the type of road necessary to withstand the constant pounding jar of heavily laden ammunition trucks and trailers.

Reports received from official British and French sources declare that the wear and tear on roads to the front is ten times as great as the traffic on Fifth avenue, New York.

THE HELTZEL LIGHTNING LOADER SKIP AS OPERATED IN CONJUNCTION WITH MOTOR TRUCKS.

THE HELTZEL LIGHTNING LOADER SKIP AS OPERATED WITH INDUTRIAL RAILWAY.

Impediments of all kinds have combined to curtail the improvement of highways throughout the United States. It is impossible to recognize how any one can advocate the cessation of road construction in this country at this time. Roads—more roads and better roads—are a war necessity.

Since the United States entered the war, however, motor truck transportation on highways has remarkably developed, due to the following reasons: The marked increase in tonnage and bulk of freight shipments; the lack of railroad equipment efficiently to handle freight; the inadequacy of railroad terminal facilities, together with the United States government priority orders.

Considering war conditions, the haulage of freight by motor trucks over highways has become commendatory in order to relieve the congestion of terminals. To relieve the railroads many classes of freight could be transferred to motor trucks more efficiently, helping to relieve congestion and the shortage of cars.

It is evident that it will be necessary for state highway departments, counties, municipalities and contractors to use motor trucks under all practical conditions for the transportation of highway materials and machinery, and that highways of inter and intrastate transportation must be improved, if commercial and agricultural activities necessary to the conduct of the war be maintained.

A program of some kind should be outlined for the improvement of such arteries of transportation as are found to be most essential, so that construction may be started at once and carried on expeditiously at a minimum cost.

The efficiency of the motor truck itself should not be lost sight of. Cost data and comparative records are available, and progressive hauling concerns anticipating entrance into this new field of operation should thoroughly acquaint themselves with every facility and labor-saving device in order to maintain operation at the maximum.

Car unloaders such as the Heltzel are widely used by hundreds of the largest road, pavement and highway builders of this country. These loaders have, in many cases, increased the hauling efficiency to the extent of 20 per cent. They are quickly installed on an open gondola car and keep the trucks constantly on the move by minimizing the delay of loading to a mere fraction of time. At the same time, the men in the car are kept continually shoveling; thus the efficient co-ordination of the working and operating force with the hauling force tends to make a smooth and efficient organization.

Questionnaires forwarded to many users of these loaders were returned, showing unprecedented results in increasing the daily tonnage handled and decreasing operating expense.

Every means at the contractor's command should be brought into play effectively to maintain the high standard of economic operation as necessitated by the present emergency.

M. C. BOYD, Manager of Sales,
Warren, O. The Heltzel Steel Form and Iron Co.

Route Your Freight Via Motor Truck

Editor MUNICIPAL ENGINEERING:

Sir—The only route at the present time that is free from embargoes, traffic congestion and delays is the motor truck route. The highways which we have been building in this country for the past few years are now proving one of the very best investments that we could have made.

These modern permanent highways now open up the only logical solution to the transportation tie-up. The motor truck of today is capable of transporting freight on short hauls, in vast quantities, at a reasonable rate and with much better dispatch than the railroads.

Motor truck freighting has the added advantage of eliminating at least two extra handlings of freight, which are always costly and the reason for undue delays.

The United States Motor Truck Company has consistently urged its various distributors and district sales managers to bring this to the attention of firms with transportation difficulties, and has been very successful in interesting large manufacturers to install a transportation system not only for their own protection, but for the relief of the railroads.

U. S. motor trucks are in operation hauling freight between near-by cities in all parts of this country. The rate charged is usually slightly less than express rates, although in some cases it has been possible to handle the business on regular freight rates and make a handsome profit.

E. S. LEE, JR., Manager of Sales,
Cincinnati, Ohio. The United States Motor Truck Co.

Resurfacing Existing Paved Streets

Editor of MUNICIPAL ENGINEERING:

Sir—The advent of the automobile and its increasingly general use, and particularly the introduction and extending use of the motor-driven truck for all sorts of delivery and general transportation service is producing profound changes in the character and design of the highway surfaces of the streets and roadways everywhere.

Not so many years ago during the horse-drawn vehicle days the principal demands made on a street or roadway surface were a reasonably smooth surface, as durable as possible, which could be built at a low initial cost.

To meet these demands many thousands of miles of streets and roadways were built of such materials which would best meet these requirements and as a result of this policy one can find examples of these types of structures scattered far and wide. The change in the fundamental requirements made of a paved surface can be best described as an insistent demand for greater smoothness and noiselessness, these demands overshadowing to some extent the desire for low first cost.

This demand has been met in some cases, at least, by an effort to surface over the existing pavements with a wearing surface which will meet these expectations for extreme smoothness and noiselessness and as a result there have appeared numerous types of paving with asphalt, asphaltic concrete, cement concrete and others of like nature applied to and covering the existing constructions.

As a general proposition such a resurfacing scheme works out quite well; the old pavements, even if not provided with the more modern concrete foundation, lend themselves very well to this treatment and consquently it is to be expected that there will be more and more of this work done.

Generally speaking, excellent service is being given by streets which are covered with a wearing coat of about 1½ ins. of asphalt surface, or similar material, placed on a binder coat of 1½ ins., which is placed directly on the existing street surface; such binder and wearing coat extending usually from curb to curb.

The cost of such a type of resurfacing compares very favorably with that of an entire new construction; with the present day very high scale of prices for all the elements of a new pavement and with the national government demanding the greatest economy in all directions, is not the resurfacing of many of our existing streets the ideal method of providing street surfaces adapted to modern needs and yet complying to a very large degree with the government's demands?

It would seem so and it is safe to say that the era of smooth resurfaced streets is just about beginning and that their use will become more and more general. Very truly yours,

Ohio City Engineer.

Motor Truck Used as Water Sprinkler, Road Oiler, Fire Extinguisher, Refuse Wagon, and for Piling and Hauling Snow

The Editor of MUNICIPAL ENGINEERING:

Sir—The motor truck illustrated herewith is used at various times as a water sprinkler, a road oiler, a fire extinguisher, a refuse collector, and when equipped with a plow is used for piling and hauling snow.

The truck is a Peerless. In summer a tank body is put on and it is used at different times either as a water sprinkler or to spread road oil. It has a pump that allows it to throw a stream some distance, so that it can extinguish small brush fires along the road. When the watering and oiling season is over, a dump body is installed that will carry 100 barrels of

PEERLESS TRUCK EQUIPPED WITH MOTOR PLOW FOR PILING AND HAULING SNOW, BOSTON, MASS.

ashes or refuse. In winter this body is used to remove snow. The plowing attachment was furnished by the Good Roads Machinery Company, of Boston. It can be put on or taken off in a very few moments.

JOSEPH J. NORTON, Supervisor
Boston, Mass. Highway Division, Public Works. Dept.

Unbroken Bulk Big Feature in Transporting Freight by Motor Trucks

Editor MUNICIPAL ENGINEERING:

Sir — Probably the greatest advantage in transporting freight by motor trucks in intercity and interstate haulage is the feature of unbroken bulk. As every one knows, time and labor in trans-shipping less-than-carload freight are costly items in moving any product. Direct delivery from shipper to consumer is possible only by the use of motor trucks. The flexibility of the motor truck is such that it is not restricted to any fixed road. It takes the shortest cut between points and circumvents any obstruction, such as going around a blocked road, detouring to avoid a damaged bridge, or selecting the best highways.

There really is no comparison between the efficiency of motor haulage and railroad haulage on less-than-carload shipments. The railways simply cannot do the work efficiently and on time. The substitution of elastic motor transportation overcomes all drawbacks imposed by the railroads. With the future development of highways, motor transportatation between points at great distances will become an established fact. Already, motor trucks are venturing into new districts. Two years ago a trip between New York and Philadelphia, by a motor truck, was a much-heralded event.

Today the motor transportation idea is becoming bolder. Columbus ventured forth on an uncharted sea with only his courage to sustain him. In the present state of country highways, the motor truckman must have an unusual degree of courage to attempt driving between certain of our cities, but we have the advantage of knowing the definiteness of our destination and get there somehow, even with the fearful handicap of our highways. If these grave difficulties of road transportation are now being surmounted by the intrepid interstate trucker, and time and money is being saved, what will be the rewards when Congress awakens to the need of practical military highways, and develops a chain of such highways between all of our principal cities and towns?

We are at the beginning of an epoch in motor transportation which promises to become one of the actual wonders of the world. Very truly yours,

D. O. SKINNER,

Advertising Manager International Motor Co.

New York.

Long-Distance Motor Trucking

Editor of MUNICIPAL ENGINEERING:

Sir—The operation of motor trucks in city haulage work is fairly well understood and even in the most severe winter weather proceeds with but slight interruption. The freight congestion, consequential to the state of war into which we have been drawn, has brought about demands for intercity haulage never before considered and which in ordinary times would probably have required years to approximate.

Motor Trucks to Save Situation

Goods must positively be moved, supplies delivered regardless of season, road or weather conditions—in fact, the word impossible has been eliminated from the transportation dictionary and as the common carriers—electric and steam lines—either can not or will not meet the unprecedented conditions existing practically all eyes are directed upon the motor truck as representing the salvation of the situation.

Probably never in the history of the motor truck industry has such an opportunity arisen to prove the value of its product. To the American truck manufacturer, who unlike his French, British, Italian and German contemporary who has enjoyed for years the recognition and support of his government, the time at last seems to have arrived when his standing and value in the commercial world will be appreciated.

Intercity Trucking a New Problem

With the exception of Massachusetts, Rhode Island, Connecticut, parts of New York, New Jersey, Pennsylvania and southern California, the subject of intercity transportation is comparatively a new problem and one which will have to be studied carefully before success may be obtained. All trucks are not properly designed or constructed to prove profitable or dependable investments for long and exacting road travel and the driver problem presents a consideration worthy of the closest study.

Better Roads Paramount Necessity

The roads of our country are unfortunately not generally constructed to meet the requirements of motor transportation and no loss of time should be allowed to elapse before universal action is taken toward their betterment or entire reconstruction. Tremendous sums of money will be required for such work, but inasmuch as every man, woman and child will be the profiter thereby any outlay intelligently and honestly conducted is justified by the conditions and grim necessities we all now face.

Limitations of Steam Transportation

Steam and electric roads in spite of the engineering skill exercised in their layout and construction are, during the winter months, often rendered absolutely inoperative by snow, and it is surprising how even a slight fall will tie up a division or entire system. Dependent as it is upon a metal to metal contact between driving wheels and rails, a locomotive is capable of negotiating only the slightest of grades, judged from a motor truck standpoint, and the snow or ice covering which may put a train schedule completely out of business hardly affects the truck at all.

Elasticity of Motor Transportation

Having a permanent right of way over which it must travel if at all, the railroad lacks the elasticity of motor transportation, which, in case of one route being blocked or flooded, can generally select another. Time may and often is lost through such a cause, but the all-important point is that the goods are delivered. Practically all of our Eastern roads are now so congested, or said to be congested, with freight impossible to deliver, as to be embargoed against the shipment of everything but perishable foodstuff—a condition impossible of arising in connection with motor transportation.

Trucks as Fast as Freight Trains

Taking into consideration the average time required during normal conditions and the delay in carrying freight to and from the railroad, a freight shipment from Detroit to New York or Philadelphia will require about seven days. Actual experience during the worst weather of the present winter conclusively shows that motor trucks transport their loads in the same time or even less. No claim is made that in such a trip the cost per ton will be as low as that of the railroad even with the cartage charges at each end of the line included, but more often than not the increased expense incurred is justified by the sureness of delivery, express time and less liability of damage.

Points to Consider in Intercity and Interstate Trucking

As mentioned in the first part of this letter, there are a number of points for serious consideration in connection with intercity and long-distance haulage which are not so important in general trucking work.

The routes, schedule, supply and service stations or bases should be carefully laid out by *competent* motor transportation men—work beyond the knowledge or capabilities of the average motor truck representative. A very careful selection of machines should be made, as in spite of what dealers or even manufacturers may say, every truck is not suited to this trying and exacting service.

Having arranged the foregoing, every precaution and pro-

vision should be made to the end that no matter what kind of weather or road conditions are encountered during the winter season, the trucks and men may cope successfully with them.

Every machine should at least carry a helper or extra man besides the driver. Each truck should be properly fitted with a cab with curtains and windshield affording complete protection to the men. Care should be exercised to see that there are no gas leaks in tank, piping or exhaust manifold as defects of this character have some times proved fatal.

Motor Supplies to Carry

A Pyrene or other approved type of fire extinguisher should be conveniently carried and the tool kit, jacks, etc., maintained in first-class working order. An electric or Prest-O-Lite gas head or spotlight should be mounted convenient to the driver or helper and a few extra parts such as valves, valve springs, plugs, etc., carried in an extra case for emergency repairs. One of a number of compact forms of block and falls with wire cable will often prove of great value and can be carried with the extra parts. A bucket of sand, shovel, extra cans of gasoline and oil and a few burlap bags take but little space and are worth a fortune often times.

Traction Chains

During a snow fall, all trucks traveling a route should be fitted with a snowplow of adjustable type in order to maintain the roads in running condition. Last and by far the most important item is that of traction chains. For country road work these should be much larger or heavier than for city use and no less than seven or eight applied to *each* of the driving wheels. They should be so designed as to be instantly attachable or detachable and the driver compelled to see that they are used only when necessary. A lighter set may also be carried for service in city delivery work, where the hard pavement would prove the others undesirable. Too much importance can not be laid upon the fitting of each wheel with a traction chain at least every 15 or 17 ins. around its circumference.

The idiotic practice of applying one or a few chains to one wheel only positively guarantees a stalled truck, due both to the action of the differential gears as well as insufficient traction of a continuous nature throughout the complete revolution of the wheel. The average truck wheel diameter is 36 ins., a circumference of 113 ins.—it should be easy to understand that one chain having passed the point of road contact will permit the wheel to gain so much momentum before it again strikes the ground as to offer little or no obstruction in its passage. For this reason sufficient numbers of chains should be applied to offer a continuous series of gripping actions. While such grips will reduce the pulling power of the motor, there is always sufficient reserve, particularly through resort to lower gear ratios, to meet any condition.

The Driver's Winter Clothes

Of equal importance to the proper equipment of the machine is the comfort and well being of the driver; too little thought has been given to clothes in the past, not only by the employer, but by the driver as well, and as a consequence neither man nor machine has delivered their greatest efficiency during the winter weather. The general get up of the North woods lumberjack is a very good combination permitting as it does freedom of movement while providing warmth. The writer has during the last nine years used a combination consisting of quilted helmet with detachable face mask, dogskin quilted long coat with split skirt, which can be transformed into trouser legs, one or more pairs of lumberman socks worn one over the other with arctics as outside covering and as many pairs of woolen gloves as conditions require, all constitute a driving uniform which will afford plenty of warmth, protection and comfort under any condition met with even without a cab and the temperature 30 degrees below zero.

EQUIPMENT HINTS FOR LONG DISTANCE TRUCKING IN WINTER. LEFT: A FAIR EXAMPLE OF HOW WHEELS ARE, BUT SHOULD NOT BE, EQUIPPED WITH CHAINS. RIGHT: A MOTOR TRUCK DRIVER DRESSED FOR A LONG, COLD DRIVE.

Thus provided and equipped there ceases to be any question as to the feasibility or success of mechanical transport over long distances during the season when the difficulties and hardships are greatest.

CHARLES E. STONE,
Transportation Engineer, J. C. Wilson Company, Detroit, Mich.

Proper Relations Between Sales Engineers, Contractors and Engineers

By Arthur W. Greetham, Manager of Excavator Sales, Pawling & Harnischfeger Co., Milwaukee, Wis.

My view of the proper relations between Sales Engineers, Contractors and Engineers is that of co-operation.

I believe that Engineers can and do, a great many times, offer suggestions to the contractor on the class of equipment necessary to handle the work. The engineer should also be willing to furnish sales engineers details of the work which would enable them to render the contractor valuable assistance in selecting equipment.

The contractor is the one individual to be most benefited by this co-operation, because it is only through the selection of proper equipment that he earns the most profit on the job and establishes his reputation as a contractor. The engineer is interested chiefly in the successful completion of his plans and he must know that the contractor properly equipped can best carry them out.

The sales engineer is not only interested in selling the contractor, but desires to place the proper equipment on the work thereby satisfying the contractor, furthering the prestige of his firm and equipment as well as being of maximum assistance to the engineer in carrying out his designs.

It has been my experience that the above relation works out nicely and I can endorse it as practical and beneficial to all parties concerned.

PLANT UNITS AND LAY OUTS

A Rotary Concrete Surfacing Machine

The Berg rotary concrete surfacer comprises a cutting tool driven through a flexible shaft by an electric motor carried by the operator. The entire apparatus weighs 30 lbs.; the tool itself weighs 9 lbs. The cutting tool consists of a disc in which are mounted 16 hardened steel cutter wheels. The cutter wheels roll on the surface to be dressed and are so designed that their teeth remove the material by a chipping action. A special stone and grinding attachment is included as standard equipment. This attachment is interchangeable with the cutting tool and is used for grinding in a mixture of cement and sand which is swabbed on the surface after the board marks and projections have been thoroughly removed by the cutting tool.

The board marks and projections are removed with the cutting tool attachment. This work should be done as soon as convenient after the forms are stripped. A mixture of 1:2 cement and white screened sand, reduced by water to the consistency of thick paint, is then swabbed on in small patches and, while still wet, rubbed in immediately with the stone grinding attachment. The action of the stone, which rotates at high speed, has the effect of grinding up the plastic material and forcing the finely ground mixture into the pores, removing the surplus, producing a thoroughly and permanently bonded, smooth surface that is impossible of production by hand. The resulting surface also has high moisture-resisting qualities.

When removing projections and fins only, in preparation for a float or rubbed finish, the surfacer will prepare 100 sq. ft. per hour. It will cut down the surface to one color, leaving a perfectly flat wall, at the rate of 70 ft. per hour. The aggregate may be exposed to a bush hammer finish at the rate of 60 ft. per hour. The stone grinding attachment will produce from 35 to 50 ft. of smooth surface per hour. The total cost of operating the surfacer, exclusive of labor, does not exceed $1.65 per day.

New Land Dredge of Walking Type

Contractors engaged in drainage and ditch work will be interested in the new type of land dredge manufactured by the Bay City Dredge Works. This is a walking dredge using a series of feet in place of the steel trucks and sectional track for moving the dredge ahead on the work.

NEW BAY CITY LAND DREDGE OF THE WALKING TYPE.

Four corner feet are attached permanently to the four corners of the dredge and two large movable feet are in the center, one on each side. The moveup cable passes over a set of sheaves and attaches to the upright or leg on each side above the middle foot. When the operator is ready to move up on the work he engages the clutches controlling the moveup drum and as the cable tightens up it gives a lifting motion to the entire dredge and transfers the weight of the dredge from the corner feet to the center feet. When the weight is removed from the corner feet the tension on the moveup cable causes the dredge to move forward over a set of rollers attached to the middle legs and resting under the longitudinal framework of the dredge. The dredge moves forward 5 to 10 ft. at a shift, the center feet, which temporarily carry the weight of the machine, remaining stationary. When the operator has moved forward the required distance, the tension on the moveup cable is released and the dredge settled on the corner feet. The center feet are then pulled forward until the front of same are flush with the rear end of the front feet. The feet are then in position for the next step.

This move ahead motion is quite rapid and an experienced man can move forward at the rate of 2 steps in 60 seconds. It is possible to move across open country from one piece of work to another at the rate of 500 to 1,000 ft. per hour.

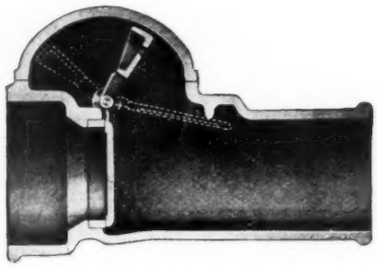
The walking dredge will work successfully over rough, marshy, soft or slippery ground. No track, skids or extra planking are required. No track men are used and labor troubles are greatly diminished. The increased speed of moving produces larger yardage and lower operating costs. This walking dredge will be found particularly desirable in drainage districts, where the yardage per station is small, where there are many laterals or where there are a series of short, detached ditches. It will be possible to move from one section of the work to another with a great deal of speed, cutting out the lost time on dead moves and proportionately increasing the monthly yardage.

This walking type of land dredge has been built for the past two years and now they are working successfully in nine different states. They are also suited for highway ditching, sand and gravel pit work, large drain tile and sewers and irrigation canals.

The Pennie Back Water and Sewer Gas Valve

The Pennie valve is for sealing the waste pipe in residences, public buildings and factories so that water, vermin or sewer air can not get back into the sewer from the building. This valve has also proven successful for keeping dry the manhole of street railway, telephone, water and gas utilities.

The closure against back-flow is effected by a balanced



bronze and cast-iron disc which fits against a brass seat, the contact surfaces being machined for close fit. The operation is made absolutely positive in any position, by fastening lead in the counterweight cup if necessary to make the disc swing to the required angle. No lead is required when the installation is applied by taking off the cap and pouring into the

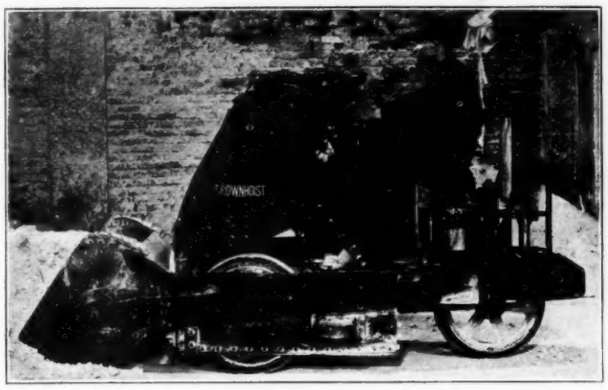
cup, which has countersunk holes in the bottom to hold the lead permanently in position.

The valve or disc need not be removed when the cup is being weighted for regulation, all that is necessary being to hold a wiping rag or flat surface under the counterboard holes to prevent escape of the lead before it hardens.

This valve, which is made by The Kennedy Valve Mfg. Co., comes in from 2 to 12-in. sizes for either standard or extra heavy soil pipe.

Power Scraper Shovel

The Brownhoist power scraper shovel is here illustrated at work in a warehouse. This machine is driven by a gasoline engine. The scraper bucket is pushed into the material to be moved and can then be raised if desired, or the material can be pushed along the surface it is resting on. The machine comes in two sizes, the smaller weighs 4 tons and has a 15 cu. ft. bucket, while the larger weighs 8 tons and has a 24 cu. ft. bucket. While this machine has been largely used in ore-handling, it can be used also in handling concreting materials.



BROWNHOIST SCRAPER SHOVEL IN USE IN A WAREHOUSE HANDLING BULK MATERIAL.

Economical Coal Storage Systems for Cities

A certain coal storage system, which has been in use for a number of years, consists of a concrete pit 300 ft. long, 100 ft. wide and 28 ft. deep. The bottom of the pit is 18 ft. below ground level and provision is made to flood the coal up to the ground level. It has a capacity of 30,000 tons, with 13,000 under water. A Brownhoist locomotive crane operates on a trestle running through the middle of the pit and handles the coal on both sides with a 1½-ton Brownhoist coal bucket. As the coal comes in it is dumped through the bottom if received in that type car or is unloaded by the crane when necessary. When coal is needed in the power plant it is loaded by the crane into the cars, which are run into the plant.

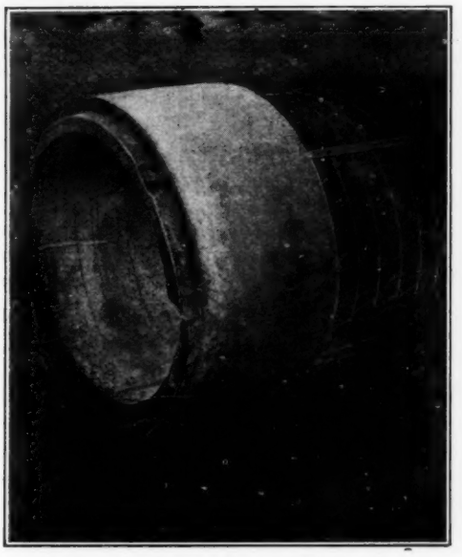
In open yard storage systems Brownhoist locomotive cranes are also used. In one yard six of these cranes are used, and the coal is stored on both sides of the track until required in the power plant. One of these cranes will handle from 75 to 100 tons per hour when working in free coal or will unload from cars 50 to 60 tons per hour. Besides handling the coal, the crane also does switching work and any other hoisting work as required around the plant.

Reinforced Concrete Pipe with Special Locking Joint

The reinforced concrete pipe with special locking joint of Keystone manufacture, here illustrated, has been manufactured for the past three years. The pipe ranges in size from 24 ins. to 7 ft. in diameter. All the pipe is reinforced with four 1¼x¼-in. bars and above 48 ins. with six steel bars 1¼x¼-in. and American triangle mesh reinforcing wire. The form is placed around the reinforcement and is then locked and filled.

Each ring of the form is in two sections, which may be easily fastened together or loosened up. A cast-iron ring fits into the top of the space between the outer and inner form, and at the bottom the opening is closed up by a similar ring. These rings are so constructed as to shape the desired notches in the ends of the pipe. The top ring is, of course, only wide enough to accomplish this purpose, and it leaves room for the mortar to enter the form. These rings also have holes for the ends of the longitudinal reinforcing, holding them in just the right position.

Sections of pipe are drawn together and locked. This is done by means of Keystone lugs and bolts. On account of the peculiar construction there is absolutely no chance for the bolts or lugs to become loosened and allow the pipe to spread. After the pipes have been locked all metal parts are covered with cement, which eliminates any chance of corrosion. This leaves a perfectly smooth surface, both on the interior and exterior of the pipe. The construction of the joints and concaves are such that one-half the concave is on top and outside and one-half on the bottom and inside. The locking of the joint prevents joint settlement.



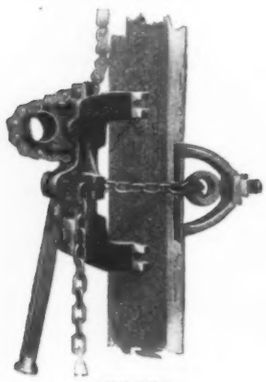
VIEW OF REINFORCED CONCRETE PIPE OF LOCKING AND SEALING TYPE.

A Chaingrip Pipe Vise with Novel Features

The Chaingrip pipe vise here illustrated is simple and portable. It fastens to any kind of horizontal or vertical support, whether round, square or flat, without the use of bolts. It locks any size pipe or conduit within its limits by a push of the lever; no previous adjustment is necessary.

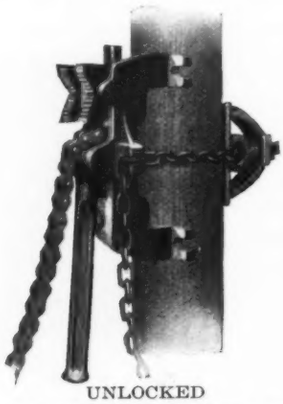
The base support of the Chaingrip is squared out in the form of an inverted V, at the sides of which are bolt lug feet, to be used only in case the vise is to be permanently bolted in one position. Hence it will conform to a round, square or flat surface. A clamp support on the opposite side of the column is a part of the Chaingrip equipment. It is a bell section shape, having a boss at the top, through which a threaded supporting eye bolt passes free. A heavy nut resting on the top of the boss, and engaging the threaded eye bolt, adjusts the tension of the chain passing through the eye of the eye bolt. The base of the clamp support is squared out in a manner similar to the vise base, in such a way that it fits the same shaped surfaces.

A heavy wrought iron chain is riveted on one side of the vise base. It passes around the supporting column, through the eye of the eye bolt in the clamp support, and thence to the other side of the vise base, a link being held securely in position in a socket. Tightening of the eye bolt nut tightens the supporting chain and holds the vise rigidly in



LOCKED

CHAINGRIP MOUNTED ON THE CORNER OF A WOOD, CONCRETE OR IRON UPRIGHT.



UNLOCKED

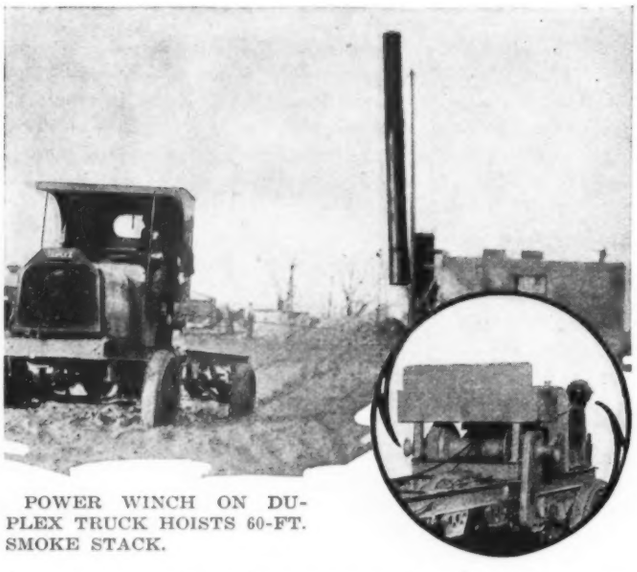
CHAINGRIP MOUNTED ON A ROUND WOOD, IRON OR CONCRETE COLUMN.

position. The Chaingrip vise locks a pipe or conduit firmly between a double set of steel pipe jaws on one side and a heavy, close-linked steel chain on the other. The locking motion is accomplished by the movement of the handle toward the vise.

Power Winch on Motor Truck Hoists 60-Foot Smoke Stack

Due to the great demand from lumber concerns, machinery houses, oil refineries and safe and machinery movers for motor trucks equipped with power windlasses, the Duplex Truck Company is now installing on its four-wheel drive truck, as special equipment, a power winch of ten tons capacity.

The power winch furnished with Duplex Trucks is operated



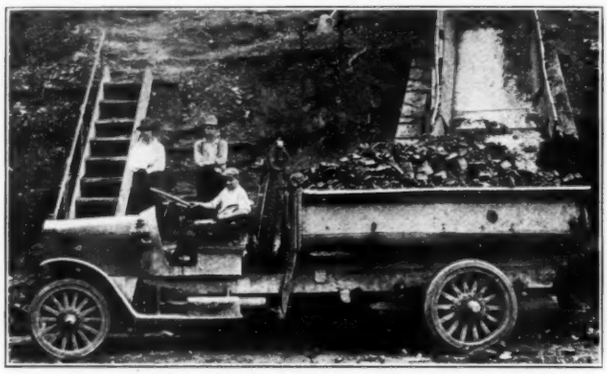
POWER WINCH ON DUPLEX TRUCK HOISTS 60-FT. SMOKE STACK.

from the transmission by a worm and worm wheel. An exclusive feature is the fact that the winch is located under the driver's seat and uses none of the space back of the seat. It has been thoroughly tested by Duplex engineers and is declared to be satisfactory in every way.

The accompanying view shows a Duplex power windlass hoisting a 60-ft. section of a smoke stack at the Duplex factory in Lansing. The section is 40 ins. in diameter and weighs 5 tons. It was easily lifted into place by the winch, the hoisting operation requiring but a few minutes.

3½-Ton Truck Replaces Seven Teams and Seven Men

A 3½-ton Acme motor truck operated by the Glass Run Coal Company of Pittsburgh, Pa., replaced seven teams and seven men in hauling coal. The roads traversed were in fair condition. The length of haul was two miles. The number of trips made per day with the truck was 14 and with team 3. Work continued with the truck from 7 a. m. to 4 p. m. The truck driver was paid $3.60 per day. The truck carried 4½



ACME 3½-TON TRUCK THAT REPLACED SEVEN TEAMS.

tons per load—a full ton above the rated capacity. There were no truck repairs necessary. The cost of gasoline was $2.16 per day; oil, 17½ cts.; grease, 5 cts.; miscellaneous expense, 1 ct.; total cost per day, $5.99½. The total mileage was 60 per day. To travel the same 60 miles per day with the same total load by team, 7 teamsters were required at $3 each and seven teams of horses, hauling 3 tons at a load. The best day's performance with the truck was the hauling of 85 tons of coal, making 19 trips for a total mileage of 80.

The Highly Developed Motor Truck Trailer

The modern motor truck trailer is fitted with solid rubber tires and the axles revolve on steel roller bearings. These trailers are "engineered" and built just like motor trucks. They are built to carry capacity loads with a 50 per cent overload allowance. Trailers are here to stay because they increase carrying capacity and reduce hauling costs. Their operating expense is negligible. The high grade motor truck has great reserve power, seldom called into action unless trailers are employed.

A 1-ton truck can pull two or even three tons on a trailer. If the trailer can be attached to the truck frame by a fifth wheel connection making what is practically a six-wheel truck, the load handled can be as great as three tons, easily. Seventy per cent of the burden is borne by the semi-trailer, 30 per cent is handled by the truck.

Semi-trailers are made, ordinarily, in 1½, 3 and 5-ton guaranteed capacities. They are furnished with standard stake bodies or bodies may be ordered to suit the special hauling requirements. This type of hauling unit is especially adapted for building supply dealers, lumber dealers, coal men, pit and quarry operators, telephone companies, manufacturers, general contractors, and road builders.

Pole trailers with extension reach and swivel bolsters which will handle long pole or pipe lengths as long as 100 ft. are used in the timber, by telephone companies, by public service organizations and the oil fields. Small two-wheel trailers, attached to any small truck or pleasure car, are used by those who can use a hauling unit of capacity not greater than 1,500 lbs.

The demand for properly built trailers is especially strong where long hauls are necessary. If the Semi-Trailer is properly "engineered," it should be built to run just as fast as the truck can pull it. It should be attacked by a connection that will nullify the bumps and jars reecived on bad roads and absorb the shocks of sudden starting and stopping. On long hauls a high-speed trailer is especially profitable because one trip it handles a capacity load that otherwise could not be taken care of less than three.

There is a strong demand for Semi-Trailers among city operators where the hauls are short because the use of trailers enables the owners to keep their trucks moving. The trailer should be the loading platform—the truck, the power unit. One operator in a middle western city operates three Semi-Trailers and one Tractor-Truck. At one end of the haul is the railroad—at the other end the lumber yard. While the semi-trailer and tractor do the work of three 1-ton trucks. being unloaded in the yard while the third is being hauled by the truck. The truck is always in motion. On each trip the semi-trailer and tractor do the work of three 1-ton trucks.

Some New Machinery for Road Builders

Now that labor is scarce, contractors are paying more attention than heretofore to machinery which will reduce the size of the gangs needed for road building. It is found that while some kinds of machinery may somewhat increase the cost of performing certain kinds of work, as compared with the cost where hand labor is used exclusively, it is to the contractor's advantage to pay this slight additional cost in order to be certain that the work will progress rapidly and be completed on time. What the contractor is interested in is the net profit on the whole contract, rather than the lowest possible price on some item of the work. If mechanical equipment will also be more economical than day labor on such an item, so much the better.

A form of grading machine is being used in an Illinois county which is typical of the labor-saving improvements recently made. It is a heavy blade grader, which digs the surface of a road and sweeps the material to one side. There is a limit, however, to the material which can be dug up by the blade of such a grader. Consequently in grading old roads which are so consolidated that the crust is very hard, it has been customary to loosen this crust in advance of the grading. The new machine makes this preliminary work unnecessary, for in front of the blades it has a head carrying five heavy teeth on the lower side. These teeth are forced into the road and tear up a strip 40 in. wide. By loosening a strip of this width the blade of the grader is able to loosen and move to one side a considerably wider section of the old roadway. This machine is hauled by a traction engine and can cut down a hard roadway for a depth of 4 in., if necessary, every time it passes over the road. In this particular case it is cutting down the road from 6 to 15 in., leaving it in good condition for a concrete pavement.

Another type of grading machine is being used on a Chicago boulevard. It has an endless belt of steel links, which carry strong buckets about 5 ft. wide, arranged like the buckets on trench digging machines. This machine crawls along just as the tanks of the British army move, and the buckets, as they are slowly moved by the endless chains, scrape off the surface of the earth and carry this material to a hopper on the top of the machine, from which it is delivered through a chute into wagons moving along beside the excavator until they are filled. Both these machines are new, and the interest shown in them is proof of the importance with which labor-saving equipment is now regarded by experienced road contractors.

ADVANCE INFORMATION ON BIG JOBS

Road Building in Michigan During 1917 and Proposed Work for 1918

By Leroy C. Smith, Deputy State Highway Commissioner. Lansing, Mich.

The war situation has had its effect upon road building projects during the past year to considerable extent. All townships and counties which were dependent upon foreign shipments of road-building material were compelled to cut down their proposed work considerably on account of the lack of railroad equipment for hauling gravel and stone.

Loss of Stone Boat Hurts

Western Michigan was particularly handicapped this year because of the loss of a large stone boat on Lake Michigan, which, during previous years, had been bringing stone in from Wisconsin for road building along the West Michigan Pike and branch highways. It was almost impossible for this boat to be replaced, all shipyards being tied up with government work. Many gravel and stone companies resorted to the use of box cars for shipping their material all during the fall of 1917, and on November 1 the Government put into effect an order known as Priority Order No. 2, which removed all open top cars, such as gondolas, from any service for hauling road material. This came at a time when contractors were trying to complete their jobs and when the county and township officials were arranging to stock the necessary material to maintain their old roads.

Much Important Work Done

Notwithstanding this handicap, many important links in the highway system of the state have been closed in during the past year. Genesee County has been rebuilding of concrete and bituminous concrete the road from Saginaw to Detroit across that county and an extension of this road is contemplated this year across Oakland County. When this work is completed a through road will be provided from Saginaw to Detroit. This is especially important since overland "driveways" have been practiced by automobile companies to make deliveries of cars and trucks.

Three Military Roads

The State has been taking active interest in road building during the past year, having in hand three roads of military importance; one at Mt. Clemens, leading to the Selfridge Aviation Field; one at Camp Custer and a detour between Detroit and Monroe on the Toledo road. These projects are all completed and open to traffic, except the Toledo road, upon which work is now being rushed and probably will be completed within a week or two. The latter road is a very important connection between Detroit and east, over which automobiles and trucks will be delivered to the seaboard, thus relieving the already congested railroads.

Good Work Despite Delays

Notwithstanding the delays and handicap, much progress has been made in road work during the past year, and it is safe to say that at least as many miles of road were completed and opened to traffic during 1917 as during 1916. However, there has been no increase in mileage completed.

$4,000,000 Available for 1918

During 1918 there will be available over $4,000,000 for road improvement in the various counties of the state. Coupled with this will be a state reward and auto tax fund, amounting to nearly $2,000,000 and a federal aid fund amounting to approximately $500,000. Many important links in the trunk line highway system of the state will be filled in, providing cars are available for shipping road building material. If railroad equipment can not be assigned to highway work this year, it will, of course, limit expenditures and make it necessary to resort to auto truck and the building of roads where local material is available.

1,000 Miles of Road Contemplated

Approximately 1,000 miles of road are contemplated this year by the State and counties. This is not an exceptionally large mileage, in fact a slight decrease over some years in the past; but the work is of a higher quality. In many cases pavements are planned and most of the work will be along lines of through roads connecting up the larger cities of the State.

Important County Work

Berrien county has available about $125,000 in direct county road tax, which will be expended upon about 15 miles of important road.

Calhoun county has $300,000 worth of county bonds available which will be expended upon 40 miles of road, in addition to $70,000 county road tax, which will be expended upon 50 miles of important road.

Genesee county has nearly $300,000 available for road work this year, which will be expended upon 40 miles of road, connecting up and resurfacing a number of miles of old state rewarded gravel road which have become inadequate.

Kalamazoo county has $130,000 available for road work; Muskegon county has $80,000 available for road improvement, and Oakland county has nearly $300,000 to be expended upon roads.

Twelve Federal Aid Projects

Construction work will start next year on twelve Federal Aid Projects, the cost of which is divided between the Federal Government, the State and the county or township through which the roads pass. These projects are outlined with a view of filling in gaps of the trunk line system of the state, upon which it is hard to secure local funds to make the necessary improvements.

On the West Michigan Pike two projects are contemplated across Allegan county and one connecting Van Buren and Berrien counties. Another project on the West Michigan Pike is to be considered between Muskegon and Shelby.

On the Mackinaw Trail three Federal Aid Projects will be built this year, one connecting up the road across Osceola county, between Big Rapids and Cadillac. Another important project is south of Grand Rapids in St. Joseph county.

On the Detroit-Chicago Highway several Federal Aid Projects are being surveyed, two in Washtenaw county between Ypsilanti and Ann Arbor and between Ypsilanti and the Wayne county line. Another project east of Kalamazoo for six miles leading towards Battle Creek and Camp Custer.

Work will be started this year on 50 miles of road between Marquette and Houghton in the upper peninsula. This road, built with the assistance of the Federal Government, will connect the iron and copper industries of the upper peninsula, which heretofore have never been connected by an important highway.

On the Wolverine Pavedway between Grand Haven, Grand Rapids and Detroit, a number of Federal Aid Projects will be built. Important among these is a gap of eight miles in Livingston county, near Howell. In addition to this, Ottawa county proposes extending their concrete pavement in the direction of Grand Rapids.

Preparing for Motor Truck Freight Haulage

In all the work contemplated during 1917 especial attention is being given to trunk line roads. It is more important now than ever that main cities of the state be connected with good roads so that trucks can be operated to take care of short-haul freight. It is improbable if the war situation will be much improved until after the war. Eastern cities are making provisions for caring for this increased traffic, and it is only a matter of time until Michigan will have to meet it.

Highway Construction in Wisconsin in 1918

M. W. Torkelson, Assistant Engineer, Wisconsin Highway Commission, writes as follows of the construction program of his department for the year 1918:

It is impossible to give this statement in any great detail. We have under consideration Federal aid work in 57 of our 71 counties, the estimated aggregate cost of which will be approximately $2,000,000. We have in addition state aid work projected in every county, the estimated aggregate of this amounting to approximately $2,500,000. In addition we have a maintenance program projected which it is expected will involve an expenditure of approximately $875,000.

As regards construction, we have adopted a middle of the road policy; that is, we expect to do such work as can reasonably be done and to leave such work as is extremely difficult of execution and such work as cannot be done except at unwarranted costs for future years. Certain trunk highway improvements we consider of sufficient importance to justify prices which ordinarily would be considered extravagant, and we expect to use our best efforts to see that these are carried out. But roads that are of minor or purely local importance can, we believe, well wait until times of less stress. The maintenance program will be our first care and we expect to devote every effort to make this a complete success, even though the construction program should thereby be reduced to a minimum. We realize that a large percentage of our highways will for many years to come continue to be unsurfaced; that travel over these roads for probably 150 days of the year is reasonably possible even under present conditions.

We believe that systematic maintenance and care will decrease the number of days when these roads are impassable to a very marked extent, and it is our belief that the benefit that will result at the present time from systematic maintenance of these roads will be much greater than that which will result from the construction of much shorter pieces of high type pavements.

This statement is, of course, general, and there will naturally be exceptions.

Proposed 1918 Road Work in Alabama

By J. B. Converse, Assistant State Highway Engineer of Alabama. Montgomery, Ala.

Road work in Alabama was curtailed to some extent during the latter part of 1917 due to war conditions and Government Priority Order No. 2. However, this has not made the State Highway Department take a pessimistic view for the year ahead. The department has believed that it would only be a question of a very short time before the importance of maintaining and building through routes to relieve the railroads of short hauls would assert itself. This has already been demonstrated by the movement of trucks from inland cities to ports of embarkation via the highways. Today in Alabama the Government is advertising for bids for an auto

truck service from Montgomery to Birmingham, a distance of approximately 105 miles; from Montgomery to Columbus, Ga., 80 miles; and from Montgomery to Andalusia, Ala., 90 miles. With facts like these before us, it is reasonable to believe that the Government, as operator of the railroads, will soon release cars for the shipment of road building material for trunk lines.

Due to the splendid distribution of road building material throughout the state, only about 25 per cent of the counties are affected by the car shortage. However, the cost and uncertainty of labor has become a serious problem for all.

The principal labor supply for roadwork in the South is the negro and the great demand for labor in the building of the many cantonments has doubled and trebled his wages with the following result: On Saturday night the average negro laborer finds himself with much more money than he needs to settle his indebtedness, and such being the case he proceeds to do the customary thing with them under such a condition—he stops work until his funds are exhausted. This state of affairs has caused the road contractor to protect himself by bidding so high that in many cases the prices are prohibitive and for a few months last fall it seemed as though 1918 work in Alabama would be confined to counties that were equipped to do the work themselves. However, the bulk of cantonment building is over now and there is hope that labor conditions will return to normal even if at a somewhat higher level.

There will be available for road work in 1918 the regular state aid and county supplement fund amounting to approximately $375,000. The Federal aid available, including past appropriations and the appropriation for the Government's fiscal year 1919, available July 1, 1918, will be $624,899.17. A like amount from the state and counties will make $1,249,798.34. Most of the state aid and county supplement fund will be probably used in supplementing Federal aid funds; however, it may be expected that $100,000 will be used distinct and separate from the Government work. The grand total of all is $1,349,798.14.

Surveys and plans have been made for 25 approved projects, comprising 171 miles of road. Contracts have been signed or work started with county forces on ten of these projects, consisting of 83 miles. It is contemplated that all of this work will be completed in 1918, and in addition thereto work will probably start on 25 other projects. These improvements are confined entirely to state trunk roads connecting main centers of population. At this date the department has contracts held up for 36 miles of the 1918 roadwork because of war conditions.

Much Construction on Lincoln Highway Contemplated in Ohio

As a result of the request of Governor Cox that every effort be put forth in each county for the improvement of the Lincoln Highway, announcement is made by Wyandotte county of an appropriation of $60,000 for such construction. Samuel J. Black, Wyandotte county counsel of the Lincoln Highway Association, states that $30,000 of this sum will come from the state through the State Highway Department and the remaining $30,000 will be provided by the county.

The funds thus made available will take care of the permanent improvement of all of that section of the Lincoln Highway between Upper Sandusky and Nevada, and will allow for considerable construction work to the west of Upper Sandusky as well.

Great constructional activity will be marked all along the route of the Lincoln Highway in Ohio in 1918. In addition to the work in Wyandotte county, permanent improvement will be undertaken in Columbianna, Stark, Crawford, Hardin, Allen, Richland, Ashland and Van Wert and Wayne counties. With such remarkable headway established it is easy to foresee the complete, permanent improvement of the Lincoln Highway across the state in 1920.

South Dakota Road Building Program for 1918

By Frank S. Peck, Highway Engineer, Pierre, S. Dak.

While the Highway Commission of South Dakota is new, having been born about August 1, 1917, South Dakota counties have long been building expensive highways under the direction of competent engineers. Lawrence county, in particular, has been in the road-building game for seven or eight years, and has expended $500,000 on her mountain roads, which are praised as up-to-date highways.

As to the road-building program for 1918, I will give a summary of the projects upon which federal, state and county aid funds have been pledged, and in all probability will be built in 1918.

Minnehaha county	$ 39,400.00
Codington county	38,832.00
Deuel county	28,943.20
Grant county	34,130.72
Moody county	30,200.00
Brookings county	20,000.00
Lincoln county	41,728.94
Total	$235,234.86

These projects are all subject to the approval of the Federal Government. All of the projects call for hard surfacing with local gravel, except Minnehaha county, which will be an asphalt-macadam proposition. We expect and have hopes of getting these projects in shape to begin advertising in early spring and start construction work as soon as weather conditions will admit.

The personnel of the South Dakota Highway Commission consists of Governor Peter Norbeck, chairman; Homer M. Derr, State Engineer, secretary; Frank S. Peck, Highway Engineer, and Fred W. Schreiber, Assistant Highway Engineer, in charge of field parties.

Need of More Intensive Maintenance and Greater Use of Machinery on Construction Indicated in Minnesota

By John H. Mullen, Deputy Commissioner of Highways, State Highway Department, St. Paul, Minn.

Preliminary reports of accomplishment on State Aid road work in Minnesota during the year 1917 indicate that approximately three-fourths of the work contemplated last spring will have been completed during the year. In round numbers this will mean approximately 1,500 miles of grading, 500 miles of surfacing and 200 bridges. The cost reports submitted to date, show expenditures for construction amounting to about $3,000,000 and maintenance $500,000, not including the work done in the three larger counties, Ramsey, Hennepin and St. Louis, which are not subject to requirements of the State Highway Department, and in which the expenditures for road construction and maintenance amounted to about $1,200,000 for 1917.

1917 a Difficult Year

It was a rather difficult problem to carry on road improvements during 1917, for the labor situation in this part of the country was very uncertain and not only was the cost of materials both high, but the materials were difficult to obtain. The net result of the year's experience from an administration standpoint, is the showing of necessity for more intensive maintenance and for the use of machinery on a greater scale in construction work. This necessitates a slightly different layout of construction plans and in the end will result in lower cost of work. Therefore, it might be said that the present condition of affairs is a very good thing for the advance-

ment of road building in that it has demanded more efficient and economical methods in handling the work.

Maintenance the Big Thing

The maintenance however, is the big thing, and even though the road building business were paralyzed an intensive system of maintenance will result in good road conditions throughout the country. For this reason the Highway Department will devote particular attention to that branch of the work during 1918 and will endeavor to maintain in as good condition as possible all of the main lines of travel. On both construction and maintenance, 1917 was marked by the much greater use of tractors and other motive power which released teams and men for agricultural work. Up to just recently, the grading and some of the construction work was considered a source of income for the farmers, and the introduction of outside machinery and equipment was somewhat resented, but a rapid transition has taken place, and now as a general thing, it is only as a contribution to the good roads cause that farmers will use their equipment on road work. The prospects for 1918 work are very good so far as available funds are concerned. As compared with the total of $4,700,000 available for 1917 there will be a total of $7,500,000 available for 1918. The increase is occasioned by a raise in the county road and bridge levies of approximately $1,000,000; increased State Aid for 1918 amounting to $500,000; the total apportionments of Federal Aid for the first three fiscal years which will be expended in 1918, amounting to $853,047; with special county levies to meet Federal Aid in amount of approximately $500,000.

Federal Aid Work

The Federal Aid work, which it was expected would be started during 1917, did not open up, excepting on the portion of the Twin Cities-Duluth highway through Chicago County. With the available funds for 1918, it is expected that most of the main lines of travel will be connected up with surfaced roads. This includes the completion of the Twin Cities-Duluth highway; the extension of the Jefferson highway to the Iowa State line; the construction of the Scenic highway through from the Twin Cities to the Cass Lake and Leech region; the National Parks highway connection to Winona and from St. Cloud to Fergus Falls; the Glacier Park highway as far west as Willmar; the Yellowstone Trail to Granite Falls; and the Chicago, Black Hills and Yellowstone Park trail from Winona to the Dakota line, which will probably be the first complete surfaced road across the State of Minnesota. This road passes through Rochester, Owatonna, Mankato and Tracy. With a small amount of work in Cook County this year, there will be first class road from the Twin Cities to Port Arthur, Ont. It was only in 1917 that the connection was made between the Ontario and the Minnesota road so that traffic was able to get through. This road has opened up a wonderful recreation district and it passes through a section of the State with which but very few of our citizens are familiar. This district is cut up by mountain ranges, beautiful streams and lakes and abounds with game and fish. The completion of the Scenic Highway, will open up another district slightly different but fully as desirable from a recreation standpoint. This is the territory through the Millelacs, Leech and Cass Lake country and includes the greater portion of the pine timber lake region. Driving through this region one is hardly out of sight of a sand beech lake at any time. The National Parks Highway will make more accessible the great chain of lakes lying in the vicinity of Osakis, Alexandria, Fergus Falls and Detroit. This territory is of a different nature than the other recreation districts as it is situated in the hard wood timber belt. This region affords probably the best bass fishing in the country and has very good facilities for tourists.

Tourist Traffic

It is expected that a great deal of tourist traffic will have to be taken care of this year, in fact last year saw a great increase in the volume of motor traffic in Minnesota. For instance, a week's traffic census on State Road No. 1, Dakota County, which is the main road leading in from Iowa to the Twin Cities, showed an average of 1,129 automobiles per day, the National Parks highway in Sherburne County carried an average of 433 automobiles per day, while other main roads leading to recreation districts, carried an average of from 250 to 600 automobiles per day. With the improvement of the main lines which is contemplated it is reasonable to assume that the main arterial highways from the south will carry on an average of 1,000 machines per day, while the main lines to the recreation districts will have as a general average about 600 machines per day. A careful count of automobile traffic has shown an average of 3½ passengers per automobile. From this basis deductions can be drawn as to volume of traffic and probably expenditures by tourists.

Interurban Buss Service

An interesting feature of road development in Minnesota, is the increase in interurban buss service, particularly in the northern part of the state, where it was not expected that such service would be patronized to any great extent. There are a great many of such lines, but one buss line in particular, 160 miles long, runs on a time schedule similar to the railroad train service, and is able to maintain this schedule with running time of over 20 miles per hour.

Freight Haulage on Highways

The freight haulage by highways has not developed to any great extent in this State as yet, but this is due partly to the fact that main lines of travel have not been connected up. The road auhorities are expecting that this traffic will come in great volume in 1918 on account of car shortage and insufficient railroad equipment, which will porbably result in the necessity for more durable types of roadway than are in use at the present time.

Minnesota has adopted the policy of building gravel surfaced roads and intends to carry this work forward this year but with the full realization of the fact that it is only a short time until our main lines of highways must be surfaced with a more durable pavement to withstand the heavy motor truck and rapid passenger vehicle traffic to which these roads will be subjected.

Features of Good Road Work in New Mexico

By James A. French, State Highway Engineer, Santa Fe, N. M.

The road building season in New Mexico covers the time from January 1 to December 31. Some few exceptions may be made to the above statement, and I herewith note them: In the high mountain ranges, where the rainfall (including snowfall) exceeds 20 in. annually, it is not advisable to attempt road construction during the months of December, January, February and March, but this area is so small in comparison with the area of the state as a whole that it should not be considered in the statement above. Another setback to extensive road construction may come during the period of an extended drouth, these drouths lasting from six to ten months and occurring at intervals of ten years or longer, hence they cannot be considered as changing the above statement. When the question is asked, then, "What is the road-building season?" or "When does it begin or end?" it may be truthfully said that the road-building season is continuous throughout the year. Frequently I have known construction camps that have worked their 313 working days in a year without the loss of a single day from inclement weather conditions.

Recent Road Expenditures

During the fiscal year, November 30, 1916, to November 30, 1917, the state expended $262,000 in roads and highway bridges. During the same period the counties expended $361,000, or a combined total of $632,000 by state and counties.

During the fiscal year, November 30, 1915, to November 30, 1916, the state expended $462,000 and the counties expended approximately $400,000, or a combined total of $862,000. The combined expenditures of 1916 exceeded the 1917 expenditures owing to the fact that the State Road bonds were available during 1916.

Money Available for 1918

During the fiscal year 1918 the state will have available $376,900 and the counties $614,900, or a combined total of $991,800.

The Forest Service has distributed to the counties having forest reserves within their boundaries $29,200. There is available and to be expended by the Forest Service under its direction $110,000 for the year 1918. Two counties have bond issues amounting to $125,000, available during 1918. Under the Federal Aid act there is available for 1918 the sum of $236,000.

The above figures indicate that there has been no lessening in the sentiment for highway construction throughout the state. The indications are that the sentiment is overwhelmingly in favor of a continued and extensive program of road building. The total sum outlined above, viz., $1,492,000, for highways during 1918 is indicative of the wishes of the taxpayers throughout the state.

The war has had some effect in our state upon certain classes of labor, more particularly the semi-skilled labor, but, generally speaking, there has not been much change, except that the prices of labor have increased.

Use of Convict Labor

Convicts are used and there have been at times from one to three camps at work during the past year, all under the honor system. Recently, under a new arrangement with the penitentiary authorities, I have made a contract with the superintendent of the penitentiary to furnish me convicts on the road grade at $1 per day of eight hours. The penitentiary furnishes all cost of the convicts, our foreman hiring the men as any day laborer would be hired. In addition, the penitentiary pays each convict 15 cents per day. After two months' work under this arrangement I am satisfied with its efficiency.

Post Roads Unimportant in Sparsely Settled States

To date eleven Federal Aid projects have been submitted to the Department of Agriculture, but so far the result has not been learned. I am of the opinion that some amendment should be made to the Federal act to give more authority to the Secretary of Agriculture to build the main highways, regardless of the post-road phase, which in this state starts roads anywhere and ends them nowhere. I believe this feeling is shared by the neighboring states, as our conditions are similar and differ from the conditions in the thickly settled states.

U. S. Intercity Parcel Post Motor Truck Routes

At the present time (February 1) the United States government either has in actual operation or has authorized seven routes for highway express and freight trains. In addition, the Postoffice Department has under advisement the establishment of 41 other main routes and 10 feeder routes to traverse various sections of the country.

The proposition laid out by the government contemplates main truck lines that will cross the country from east to west and from north to south, with numerous feeder routes. The plans of the Postoffice Department in this connection were explained in Chicago recently by James I. Blakeslee, Fourth Assistant Postmaster General, in charge of the rural free delivery branch of the postal service, in addressing the newly organized Highway Industries Association.

"The Postoffice Department is deeply interested in the progress of road work," Mr. Blakeslee said. "In every producing section of the country today there is bound to be a reduction in production, a condition brought about by the fact that so many men have been called into war service.

"It is vitally essential that there should be an increase in production and one of the best ways to bring this about is to give the producer the best possible means of transportation. To this end we would inaugurate a vast system of motor truck lines, over which manufactured articles as well as farm products might be transported cheaply and quickly from the producer to the consumer.

"Along one line of motor truck transportation now in service we investigated and discovered that under the ordinary system it was necessary to handle a case of eggs 14 times between the producer and the consumer. Our truck line delivers a case of eggs with only two or three handlings at the most.

"On a two weeks' test between Philadelphia and Oxford, Pa., a distance of 120 miles, our truck surmounted all difficulties, including snow and ice, and was not more than 20 minutes behind schedule at any time.

"The government motor truck service as laid out would consist of trunk lines or through connection routes and feeder or short-line routes. The trunk lines naturally would be located between large cities in order that a good market would be available at both ends of the route. In this way the trucks would be loaded going both ways.

"Feeder routes could be located so as to provide for quick transportation from the main lines to the various markets provided, thereby bringing the producers in the great garden truck territories into direct daily communication with the consumers. The plans call for about 125 trucks to start."

The government lines now in operation and authorized include the operation of trucks between Philadelphia and Baltimore, Baltimore and Washington, Columbus and Zanesville, Philadelphia and Atlantic City, Washington and Leonardtown, Baltimore and Solomon Island, and Baltimore and Lancaster. The other fifty main and feeder lines will cover various routes through the east, central west and the south.

Lines between Chicago and Springfield, O., and between Chicago and Indianapolis are expected to be in operation within the next sixty days.

According to Mr. Blakeslee, the object is to enlarge the delivery zone of every city through which the lines will pass. This should have a tendency not only to prevent prices of produce from going higher, but should reduce them.

On the motor truck mail route between Washington and Baltimore trucks leave each city daily at 6 a. m. The truck trains meet midway between the two cities, exchange loads, and return to their starting points.

COMING CONVENTIONS

UNITED STATES GOOD ROADS MACHINERY EXHIBIT—Exhibit at Little Rock, Ark., April 15-19. Sec'y., J. A. Rountree, 1021 Brown-Marx Bldg., Birmingham, Ala.

UNITED STATES GOOD ROADS ASSOCIATION—Will convene in Little Rock, Ark., April 15-17. U. S. Senator J. H. Bankhead, Pres. Sec'y., J. A. Rountree, 1021 Brown-Marx Bldg., Birmingham, Ala.

BANKHEAD NATIONAL HIGHWAY ASSOCIATION—Will convene in Little Rock, Ark., April 18-19. T. S. Plowman, Pres. Sec'y., J. A. Rountree, 1021 Brown-Marx Bldg., Birmingham, Ala.

HOW THE CONTRACTORS ARE BIDDING

Bidding Prices on Enlargment of Rapid Sand Water Filters at Fort Worth, Texas

Table I herewith gives in parallel columns the engineer's estimate of cost and the bids submitted on the enlargement of the water filtration plant at Fort Worth, Texas, by the construction of additional filters. The bids were received January 30, 1918. J. VanZuben is city engineer and John H. Gregory, 170 Broadway, New York, is consulting and designing engineer on the work. The contract was awarded to the Pittsburgh Filter Manufacturing Company, Pittsburgh, Pa.

Some Unit Bids Submitted on Okmulgee, Okla., County Roads

Herewith are given some of the unit prices bid by various contractors on the Okmulgee County, Oklahoma, Roads on December 11, 1917, as furnished this journal by Harrington, Howard & Ash, Consulting Engineers, Kansas City, Mo.

Park-Moran Company

The Park-Moran Company, bidding on nine sections, bid from $2.18 to $2.40 per square yard for monolithic brick complete.

Hanlon & Okes

Hanlon & Okes, bidding on ten sections, bid $1.85 per square yard on bituminous macadam complete, and $2.35 on asphaltic concrete complete. Their bid on five sections was $1.96 for concrete complete.

J. K. Shinn

J. K. Shinn bid $2.30 per square yard on concrete pavement complete on four sections and $2.34 on two sections.

James Stanton

James Stanton bid $2.24 on concrete pavement complete on three sections and $2.22 on three other sections.

W. A. Swatek & Co.

W. A. Swatek & Co., bidding on three sections, bid $2.05 per square yard on bituminous macadam complete, $2.15 on concrete complete and $2.41 on monolithic brick complete.

Warren Bros. Company

Warren Brothers Company, bidding on 13 sections, bid from $1.33 to $1.39 on asphaltic concrete No. 1, except base, and from $1.28 to $1.34 on asphaltic concrete No. 2, except base. They also bid from 88 cts. to 94 cts. on labor on wearing course of asphaltic concrete No. 1 and No. 2.

J. J. Harrison Construction Company

The J. J. Harrison Construction Company, bidding on 19 sections, bid $1.40 ($1.50) per cu. yd. on solid rock excavation, 70 (80) cts. on intermediate excavation and 40 (40) cts. on common excavation; $30 ($25) per 1,000 ft. on machine grading; 20 (40) cts. per lin. ft. on rock subdrains; from 85 cts. to $1.50 ($1.25) for placing 12 to 18-in. culverts per lin. ft., $1.72 to $3.20 ($1.75) on 24-30-in. culverts and $2.21 to $4.95 ($2.25) on 36-42-in. culverts; $9 ($9) per cu. yd. on rubble stone headwalls for drains; from $6.40 to $14 per cu. yd. for hauling and placing slabs in culverts ($8.25); 65 cts. ($1.25) for paving waterways slab culverts, and $9 ($10) per cu. yd. for rubble stone masonry in culverts.

S. P. Romans

The bids of S. P. Romans covered the same items as those of the J. J. Harrison Company and are given in parenthesis in each case after the Harrison bid.

F. P. McCormick

The bids of F. P. McCormick covered the same items, in general, as those of the Western Paving Company, and are given in parenthesis in each case after the Western bid. The Western Paving Company bid $1.68 ($1.80) on solid rock, 84 (90) cts. on intermediate, and 48 (40) cts. on common excavation, respectively; $36 ($40) on machine grading per 1,000 ft; 24 (25) cts. on rock subdrains per lin. ft.; from $1.02 to $1.80 ($1.85) for placing 12-18-in. culverts per foot; $2.06 to $3.84 ($3.85) for placing 24-30-in. culverts per ft.; $2.65 to

TABLE I—ENGINEER'S ESTIMATE OF COST AND CONTRACTORS' BIDS FOR ENLARGING MECHANICAL FILTER PLANT AT FORT WORTH, TEXAS.

	Item	Quantity	Engineer's Estimate Price	Engineer's Estimate Amount	Pittsburgh Filter Mfg. Co. Pittsburgh, Pa. Price	Pittsburgh Filter Mfg. Co. Pittsburgh, Pa. Amount	N. Y. Continental Jewel Filtration Co., New York, N. Y. Price	N. Y. Continental Jewel Filtration Co., New York, N. Y. Amount
1.	Excavation	1,800 cu. yds.	$ 0.50	$ 900.00	$ 1.05	$ 1,890.00	$ 1.25	$ 2,250.00
2.	Removing vault and appurtenant work	lump sum	.....	500.00	.....	200.00	.....	1,200.00
3.	18-inch sewer	lump sum	.....	400.00	.....	600.00	.....	425.00
4.	Steam supply main	lump sum	.....	580.00	.....	950.00	.....	1,200.00
5.	Cast iron pipe	16 tons	80.00	1,280.00	138.00	2,208.00	152.00	2,432.00
6.	Bell and spigot special castings	3 tons	100.00	300.00	200.00	600.00	240.00	720.00
7.	Concrete in substructure and superstructure	lump sum	.....	6,540.00	.....	8,000.00	.....	13,000.00
8.	Miscellaneous steel and cast iron fittings	lump sum	.....	300.00	.....	450.00	.....	1,300.00
9.	Filter tanks	4	2,600.00	10,400.00	1,600.00	6,400.00	2,500.00	10,000.00
10.	Strainer systems	4	1,575.00	6,300.00	1,500.00	6,000.00	3,157.00	12,628.00
11.	Filter gravel	lump sum	.....	1,100.00	.....	1,000.00	.....	2,347.00
12.	Filter sand	lump sum	.....	1,800.00	.....	2,800.00	.....	4,800.00
13.	Rate controllers and loss of head gages	4	1,200.00	4,800.00	.....	.....	.....	.....
	A—Builders Iron Foundry make	4	.....	.....	1,200.00	4,800.00	1,725.00	6,900.00
	B—Pittsburgh make: Venturi type	4	.....	.....	900.00	3,600.00	.....	.....
	C—Pittsburgh make: Self-contained type	4	.....	.....	700.00	2,800.00	.....	.....
14.	Operating tables	4	700.00	2,800.00	.....	.....	.....	.....
	A—Pittsburgh make	4	.....	.....	490.00	1,960.00	.....	.....
	B—New York make	4	.....	.....	.....	.....	480.00	1,920.00
15.	Filter gallery piping	lump sum	.....	13,000.00	.....	.....	.....	.....
	A—With Ludlow valves	lump sum	.....	.....	.....	19,000.00	.....	22,200.00
	B—With Renselaer valves	lump sum	.....	.....	.....	18,000.00	.....	.....
16.	24-inch wash water meter	lump sum	.....	2,350.00	.....	.....	.....	.....
	A—Builders Iron Foundry make	lump sum	.....	.....	.....	2,500.00	.....	2,700.00
	B—Pittsburgh make	lump sum	.....	.....	.....	1,300.00	.....	.....
17.	Wash water tank control	lump sum	.....	800.00	.....	500.00	.....	800.00
18.	Moving wash water pump	lump sum	.....	250.00	.....	300.00	.....	375.00
19.	Chlorine control apparatus—stationary type	lump sum	.....	950.00	.....	800.00	.....	1,050.00
20.	Chlorine control apparatus—portable type	lump sum	.....	450.00	.....	550.00	.....	625.00
21.	Building construction	lump sum	.....	7,500.00	.....	7,000.00	.....	9,100.00
	Total—Maximum			$63,300.00		$68,508.00		$97,972.00
	Total—Minimum			63,300.00		64,308.00		97,972.00

$5.95 ($5.85) for placing 36-42-in. culverts per foot; $10.80 ($10.90) for rubble stone headwalls for drains, per cu. yd.; $7.68 to $16.80 ($10.10) for hauling and placing slabs on culverts per cu. yd.; 80 ($1.00) cts. per sq. yd. for paving waterways slab culverts; $1.73 to $1.93 ($1.85) per sq. yd. for bituminous macadam; $1.00 ($1.08) per sq. yd. for broken stone paving base in place; $1.28 (—) for asphalt concrete paving No. 1 except base; $2.28 to $2.34 (—) for asphalt concrete pavement No. 1 complete; $1.23 ($1.32) for asphalt concrete pavement No. 2 except base, and $2.23 ($2.35) for asphalt concrete pavement No. 2 complete.

Bids on Pipe Drainage System at Garden Prairie, Ill.

On November 15, 1917, bids were asked by the commissioners of Coon Creek drainage district, at Garden Prairie, Ill. Bids were asked for the furnishing and laying of 4,222 ft. of 27-in. tile; 3,200 ft. of 26-in.; 3,100 ft. of 24-in.; 700 ft. of 22-in.; 2,600 ft. of 14-in.; 600 ft. of 12-in.; 7,175 ft. of 10-in.; 4,965 ft. of 8-in.; 3,070 ft. of 6-in.; also 1 intake for 22-in. tile and 6 cement bulkheads.

Bids were accepted separately for material and for all labor, including hauling, etc.; also for the complete job.

The following are the total quantities required of each sized tile: 3,070 ft. 6-in.; 4,965 ft. 8-in.; 7,175 ft. 10-in.; 600 ft. 12 in.; 2,600 ft. 14-in.; 700 ft. 22-in.; 3,100 ft. 24-in.; 3,200 ft. 26-in. and 4,222 ft. 27-in.

On the tile the 22 to 27-in. trench was from 4½ to 6 ft. deep. Balance of the work ranged from 3 ft. deep to 6 ft. The work of hauling the tile an average of 4 to 5 miles was let at $30 per carload, each carload making about 10 wagon loads. No bids were received for laying 22, 24 and 26-in. tile. This work and 10 miles additional will be let some time this winter, reports Arthur L. Webster, municipal and drainage engineer and county surveyor, Wheaton, Ill., engineer on this work.

The following bids were received:

Millard Carr, DeKalb, Ill.—

2,175 ft. 10-in. at 16 cts.; 600 ft. 12-in. at 20 cts.; 2,600 ft. 14-in. at 29 cts.; 4,222 ft. 27-in. at 61 cts.

Frank Greene, Garden Prairie, Ill.—

—McCue Connection—

425 ft. 6-in. at 6 cts.

—Line "Y"—

2,700 ft. 10-in. at 10 cts.; 200 ft. 6-in. at 5 cts.; 545 ft. 6-in. at 5½ cts.; 100 ft. 6-in. at 5½ cts.; 100 ft. 8-in. at 7½ cts.

Alex. Larson, Wheaton, Ill.—

—John Wallace Branch—

2,300 ft. 10-in. at 12 cts.; 1,415 ft. 8-in. at 14 cts.; 1,500 ft. 8-in. at 15 cts.; 1,800 ft. 6-in. at 10 cts.

—McCue Connection—

425 ft. 6-in. at 8 cts.

—Line "Y"—

2,700 ft. 10-in. at 15c.

—Branch No. 1, Line "Y"—

200 ft. 6-in. at 7 cts.

—Branch No. 2, Line "Y"—

545 ft. 6 in. at 7½ cts.

—Newman Connection, Line "Y"—

100 ft. 6-in. at 7½ cts.

—Beckington Connection, Line "Y"—

100 ft. 8-in. at 8 cts.

Wm. Wallace, Marengo, Ill., bid a lump sum of $250 on the 2,300 ft. 10-in., John Wallace branch.

Trade Notes

The general offices of The Pioneer Asphalt Co. of Chicago and Lawrenceville, Ill., are now at 7323 Woodlawn avenue, Chicago. The Company will continue to produce a full line of bituminous products of the highest quality and asphalts for every purpose. They will also continue to handle paints, pipe coatings, expansion joint, mineral rubber, insulation compound, filler, roofing cement, waterproofing and other bituminous products of like nature.

The Pacific Derrick & Hoist Co., 3223 First Avenue, South, Seattle, Wash., is the new name of The Burbank Machinery Co. The personnel of the Company remains the same. The new name is more indicative than the old of the specialty in service now being rendered.

The Kentucky Rock Asphalt Co., Louisville, Ky., are the successors in Kentucky of the Wadsworth Stone and Paving Co. of Lambert street, and P. R. R., Pittsburgh, Pa., asphalt and cement paving contractors.

After an existence of nine years as a department of the Chicago Pneumatic Tool Company, the motor truck interests of the company were on January 1st taken over by a new organization known as The Little Giant Truck Company. From small beginnings the motor truck department of the Tool Company had grown to such proportions that a separate organization to handle its many and varied interests became absolutely necessary—this growth was particularly marked during the past year. A good staff of active dealers eager to ally themselves with a twenty-five year old concern—a complete line of motor trucks from one to five tons capacity, the Duntley Gas Generator which permits the use of cheap fuels such as kerosene and distillate as an exclusive feature—have helped to build up the prestige of the Little Giant truck and to practically double the volume of business during 1917. The Little Giant Truck Company is owned and controlled by the Chicago Pneumatic Tool Company, and the officers are the same, W. O. Duntley, President; W. B. Seelig, Secretary; L. Beardsley, Treasurer; with T. J. Hudson, Sales Manager. The headquarters will remain in the Little Giant Building, 1615 Michigan avenue as heretofore.

There has been a consolidation of the Moline Automobile Company, makers of Moline-Knight motor cars and the Root & Van Dervoort Engineering Company into Root & Van Dervoort Engineering Company of East Moline, Illinois, an Illinois corporation. The officers and management remains the same and there is no change whatever other than in the name of the company. In the past these two companies have always been virtually synonymous, operating, however, under the two firm names under the control of the same general officers. For the season of 1918 the Root & Van Dervoort Engineering Company, in addition to building Moline-Knight automobiles, will have a big production of stationary engnes, tractor and automobile motors, besides filling large United States Government contracts. The Moline-Knight automobiles will be built in two chassis, one 40 H. P. and the other 50 H. P., known as the Models "C" and "G" respectively with prices running from $1,650 to $2,280.

The Concrete Mixing and Planing Co., Chicago, has removed its offices from 123 W. Madison street, to the First National Bank Bldg.

PERSONAL ITEMS

ALEXANDER POTTER, C. E., consulting engineer, 50 Church street, New York, has been engaged by the U. S. Government to act as consulting engineer in the design and construction of the sewerage, drainage and water supply systems for the new U. S. Government Explosive Plant, to be located near the Charlestown, W. Va., and upon which the government will expend some sixty millions of dollars.

ROBERT L. FOX, formerly of Johnstown, Pa., is the new city engineer of Bethlehem, Pa.

GEORGE H. LUTHER and JAMES M. HOMER have been appointed water commissioner and commissioner of public works, respectively, of Olean, N. Y.

W. L. YOUNCE has been reappointed general superintendent of the New Castle, Ind., water and light plant. He has held this position since 1914.

ARNOLD B. MACSTAY has been appointed commissioner of the Department of Street Cleaning of the City of New York to succeed J. T. Fetherston. Mr. MacStay was formerly secretary of the department and later deputy commissioner. The salary of this position is $7,500 per annum.

C. A. BINGHAM has been appointed city manager of Waltham, Mass. He was formerly town manager of Norwood, Mass.

GEO. M. COMEY, WM. ASHLEY, A. M. TOWER, ELLSWORTH SHERWOOD, HERMAN, LUDWIG, HERBERT A. MOREAN, HENRY M. TOOLE, ADOLPH GEDEON, WILSON M. GRAYELL, NICHOLAS GERTEN, CLAYTON FARRIS, E. S. FAIRLEY, RAY WILSON, F. W. TRUEX and JOSEPH U. SULLIVAN, all former employes of the Lakewood Engineering Co., are now in the U. S. military service.

V. K. MCBRIDE, until recently advertising manager of the American Motor Truck Co. of Detroit, has been commissioned a captain in the ordnance department, with headquarters at Washington.

OTTO F. FITZPATRICK, for seven years assistant city engineer at Crawfordsville, Ind., has been appointed city engineer at that place.

D. T. PIERCE, for some years executive assistant of the Barber Asphalt Paving Co., Land Title Bldg., Philadelphia, Pa., is in France on a special mission for the American Red Cross.

FRANCIS E. DANIELS, assistant engineer with the Pennsylvania State Department of Health, is now captain in the Sanitary Corps, stationed at Camp Greene, Charlotte, N. C.

C. A. RASMUSSEN, formerly superintendent of the water and light department at Clay Center, Kans., has been appointed to a similar position in McPherson, Kans., to succeed Arthur Groesbeck, resigned.

LOGAN WALLER PAGE, GEORGE H. PRIDE and HENRY G. SHIRLEY have been appointed members of the highway transport committee of the Council of National Defense. Mr. Page is director of the U. S. Department of Public Roads and Rural Engineering. He is a graduate of the Virginia Polytechnic Institute and also of Harvard University, class of 1893. Mr. Pride is president of the Heavy Haulage Co., of New York City. He is a graduate of Columbia University. Mr. Shirley is chief engineer of the Maryland State Roads Commssion, Baltimore, Md. He is a graduate of the Virginia Military Institute, class of 1896, and has the degrees of C. E. and Dr. S. He was formerly with the New York Central and Hudson River Railroad, District of Columbia Engineering Department, Washington, D. C., assistant engineer with the Baltimore & Ohio Railroad, and county engineer for Baltimore county.

WALDO S. COULTER has opened offices as a consulting, designing and supervising engineer in the Engineering Building, New York. He was formerly a member of the engineering firm of Hansen & Coulter, dissolved.

HENRY BECK has been appointed service director of Elyria, O. He was formerly engaged in the contracting business in that city.

HENRY W. KLAUSMAN has been appointed city engineer of Indianapolis, Ind. He was city engineer of Indianapolis during Mayor Shank's administration and was county engineer from 1901 to 1910. The extensive sewage treatment experiments conducted in Indianapolis were under his direction. He succeeds Mr. Jeup.

AVERY THOMPSON has been appointed city manager of Phoenix, Ariz., succeeding Robert A. Craig, who goes to Santa Barbara, Calif., in a similar capacity.

CATALOG REVIEWS

The Monograph.—Illustrates and describes the Lanham Monograph for measuring flow of water or gases through mains or conduits, especially in water waste surveys. Issued by the Water Works Equipment Co., 50 Church St., New York. 6x9 ins.; 14 pp.

Hammer Pulverizer.—Illustrates and describes the K-B pulverizer, an all-steel hammer-mill for pulverizing moderately hard materials. 6x9 ins.; 20 pp. Issued by K-B Pulverizer Co., Inc., New York City.

Water Waste Detection.—Literature issued by The Pitometer Co., N. Y. Edison Bldg., New York City. The Cole Pitometer System; 6x9 ins.; 62 pp. Illustrates and describes the instruments used on water waste survey work and gives directions and tables. The Cole Recording Pitometer; 6x9 ins.; 12 pp. Illustrates and describes this instrument. The Cole Pitometer System—Instruments 6x9 ins.; 8 pp. Leaflets on Water Conservation by cities and reasons for use of Pitometer Pump Slip Indicator.

Montezuma Asphalt.—Issued by Warner-Quinlan Asphalt Co., 79 Wall St., New York City and Syracuse, N. Y. 8x11 ins.; 56 pp. Gives views showing contsruction of asphalt pavements and reproduces testimonial letters. Gives specifications met by this asphalt and other technical information on asphalt.

Water Works Tools and Supplies.—Literature issued by A. P. Smith Mfg. Co., East Orange, N. J. Illustrates and describes the following water works specialties: The "Kellogg" Removable Plug; Corporation Tapping Machine; Smith All-Pressures Valve; French Pipe Cutting Machine; Wood Water Meter Testing Machine; French Patent Lead Remover; Tapping Apparatus; Devices for Filling Sprinkling Wagons; Valve Inserting Machine; Calking Machine; Lead Melting Furnace; and, the Smith Hydrant.

Electro-Chemistry Applied to Sewage Disposal.—Issued by Electrotylic Purification Co., 15th St., and Lehigh Ave., Philadelphia, Pa. 6x9 ins.; 79 pp. Written by F. N. Moerk, Mem. Am. Electrochemical Soc., and Mem. Am. Chem. Soc. Sets forth in detail principles involved in treatment of sewage by electro-chemical process.

Hoist Tower Equipment.—Issued by Archer Iron Works, 34th Place and Western Ave., Chicago. Catalog No. 16; 6x9 ins.; 20 pp. Illustrates and describes full and varied line of hoist tower equipment for concreting.

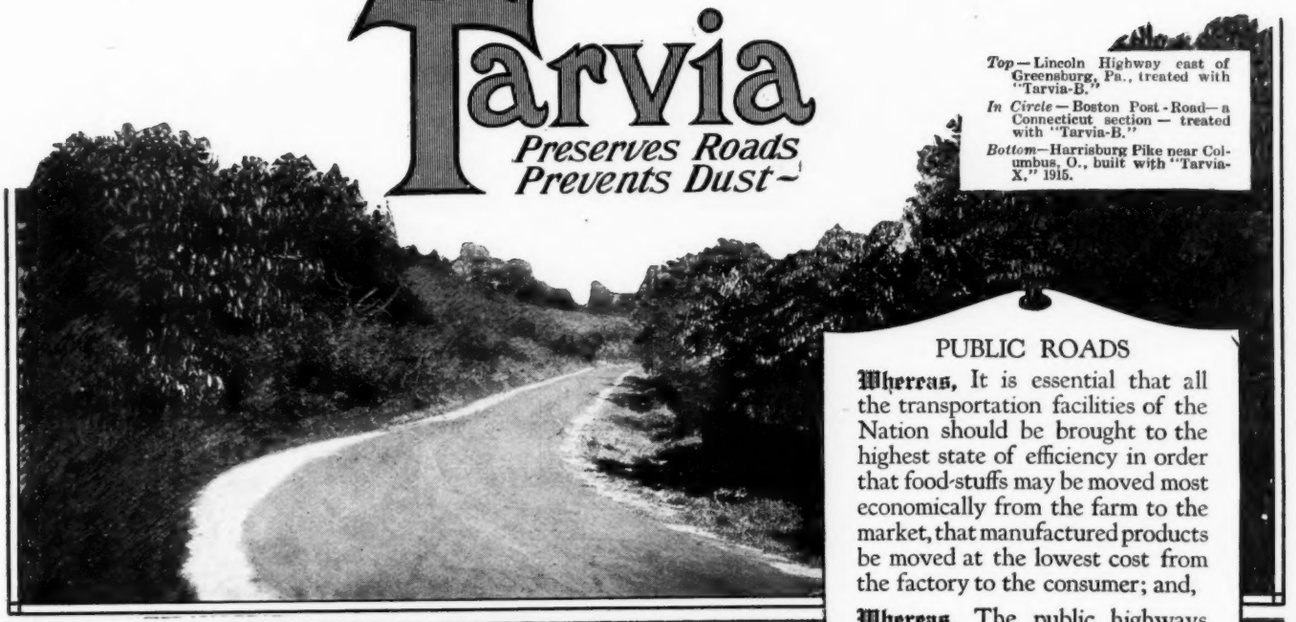
Reinforced Concrete in Factory Construction.—Issued by The Atlas Portland Cement Co., 30 Broad St., New York. 6x9 ins.; 250 pp. A thoroughly technical discussion of textbook proportions. Fully illustrated. Illustrates and describes numerous reinforced concrete factory buildings

Cleaning of Water Mains.—Illustrates and describes apparatus and methods employed in the mechanical cleaning of water mains. Issued by the National Water Main Cleaning Co., 50 Church St., New York. 6x9 ins.; 22 pp. Gives data on cost and results.

Buckets and Wagon Loaders.—Issued by The Geo. Harris Mfg. Co., Inc., 141st St. and Rider Ave., New York City. Hais Digging Wagon Loaders; 6x9 ins.; 8 pp. Gives specifications, description and performance of this loader. Hais Buckets; 6x9 ins.; 8 pp. Illustrates and describes the design and operation of the contractor's bucket.

Tarvia

Preserves Roads
Prevents Dust



Top—Lincoln Highway east of Greensburg, Pa., treated with "Tarvia-B."

In Circle—Boston Post-Road—a Connecticut section—treated with "Tarvia-B."

Bottom—Harrisburg Pike near Columbus, O., built with "Tarvia-X," 1915.

Good Roads to the Rescue of the Nation!

Our industrial and military mobilization has overwhelmed the railroads.

Embargoes, a desperate expedient to relieve the glut, are incessant embarrassments to shippers.

Even the Government cannot get its freight through. In some railroad yards the wrecking-derricks are used to get particular cars out of the jam by lifting them bodily from the side-tracks to the main-line. Switch-yards get so full that the main-lines are blocked by waiting trains.

But in those sections where long level routes of good roads connect the cities, motor-trucks are accomplishing marvels of long-distance transportation.

More and more New England is delivering to New York that way, and the Boston Post-Road hums with the endless procession of heavy trucks.

Detroit is sending great caravans all the way to the seaboard, and that is a feat because all the roads are not good.

And one impassable mile in the journey is enough to clog the whole line.

Keep the roads good! Make them fit for the new traffic! That should be the watchword!

Construct and treat your roads with Tarvia. It will make them not only automobile-proof, but motor-truck-proof.

Its use will exclude frost and rain and make an *all-the-year-round* road. It saves labor in replacements and repairs.

The use of Tarvia will insure *good roads at the lowest possible cost.*

PUBLIC ROADS

Whereas, It is essential that all the transportation facilities of the Nation should be brought to the highest state of efficiency in order that food-stuffs may be moved most economically from the farm to the market, that manufactured products be moved at the lowest cost from the factory to the consumer; and,

Whereas, The public highways offer a good, prompt, and economical means to supplement transportation by rail and water; therefore,

Be It Resolved, That the prompt improvement of our public highways is important and should be forwarded in every proper way.

—Resolution adopted at War Convention of the Chamber of Commerce of the United States, held at Atlantic City, September 18th to 21st, 1917

Special Service Department

This company has a corps of trained engineers and chemists who have given years of study to modern road problems. The advice of these men may be had for the asking by any one interested.

If you will write to the nearest office regarding road problems and conditions in your vicinity, the matter will have prompt attention.

The Barrett Company

New York, Chicago, Philadelphia, Boston, St Louis, Cleveland, Cincinnati, Pittsburgh, Detroit, Birmingham, Kansas City, Minneapolis, Nashville, Salt Lake City, Seattle, Peoria

THE BARRETT COMPANY, Limited:
Montreal, Toronto, Winnipeg, Vancouver, St. John, N. B., Halifax, N. S., Sydney, N. S.

TRADE B MARK

CONTRACT NEWS

CONTRACTS AWARDED

ROADS AND STREETS.

Ark., Jonesboro—J. F. Morgan & Co., Attalla, Ala., award. contr. for rd. construction by Commrs. Jonesboro-Nettleton Rd. Dist., Craighead County at $125,589.

Ark., Walnut Ridge—Newman B. Gregory, Texarkana, Ark., award. contr. for constr. of 12 mi. of rd., connect'g Lauratown, Portia, Black Rock and Powhatan, at abt. $80,000.

Cal., Hanford—Raisch Improvt. Co., San Francisco, award. contr. for grading and paving approx. 6 miles Kings Co. Hwy., at $48,145.

Cal., Los Angeles—Geo. S. Benson & Sons, City, award. contr. for grading and construct'g conc. pavement (11 mi.) on state hwy., Monterey Co., at $104,772.

Cal., Riverside—Johnson-Shea Co., P. O. Box 906 Riverside, award. contr. for construct'g 8¾ mi. Co. Hwy., in Coachella Valley at cost of $99,579.

Cal., Sacramento—W. M. Ledbetter, Pacific Elec. Bldg., Los Angeles, award. contr. on 3¾ miles state rd., San Diego Co., at $77,993.

Cal., Sacramento—Healy-Tibbitts Constr. Co., 9 Main St., San Francisco, award. contr. for construct'g 13.25 mis. conc. rd. on Sacramento River Levee at Grand Island, at $137,308.

Cal., Sacramento—David H. Ryan, 101 Broadway, San Diego, award. contr. for construct'g state hwy., San Diego Co., at $45,912.

Cal., San Bernardino—Phillips & LeClaire, local, award. contr. for conc. pavement 4 in. thick on Cattick St., at $98,299.

Cal., Santa Barbara—Fairchild-Gilmore & Wilton, award. contr. for Salsipuedes paving, at $16,919.

Cal., Tulare—Federal Constr. Co., Sharon Bldg., San Francisco, award. contract for paving several streets, at $34,000.

Cal., Venice—Venice Contract'g Co., local, award. contr. for grading and construct'g 5-in. conc. pavement on Redondo Dr., at $31,869.

Cal., Yuba City—Federal Construction Co., local, award. contr. for paving several streets, at $21,939.

Ct., Hartford—De Michiel & Bro., Torrington, award. contr. by State Hwy. for bldg. rd. in Woodbury, at $30,000.

Fla., Kissimmee—Peninsular Engineering & Contracting Co., Tampa, award. contr. for hardsurfacing 45 mi. Sunrise & Sunset Trail, at $275,000.

Fla., Quincy—W. P. Kennedy Constr. Co., Tampa, award. contr. for 23,000 sq. yds. street paving, at abt. $50,000.

Idaho, Moscow—Standard Asph. Co., Spokane, Wash., award. contr. for improving Blake Ave., at approximately $14,000.

Ill., Maywood—Edwin Johnson, 30 N. La Salle St., Chicago, award. contr. for paving, at $29,000.

Ill., Oak Park—J. A. Sackley Co., 133 W. Washington St., for 17,300 sq. yds. asph.-conc. paving, at $30,850; H. G. Goolitz Co., Oak Park, 11,580 sq. yds. asph.-conc. paving, at $32,767; Standard Pavg. Co., 29 S. La Salle St., contr. for 7,392 sq. yds. asph.-conc. paving on 6-in. conc. fdn., at $22,819.

Ill., Ottawa—Jos. Leix, 322 W. Main St., City, award. contr. for grading, draining, curbing and paving, at $4,576. John Cherry, Jacksonville, award. contr. for paving, at $51,186.

Ind., E. Chicago—Shea & Co., Hammond, award. contr. for conc. pavement, at $11,900.

Ind., Elkhart—Northern Construc. Co., City, award. contr. for paving Franklin St., at $23,335.

Ind., Huntington—Federal Asph. Paving Co., 316 Rentschler Bldg., Hamilton, Ohio, award. contr. for resurfacing Matilda St., at $50,698.

Ind., Lafayette—Slattery & Burke, City, award. contr. by Tippecanoe Co., for bldg. 2.83 mi. of W. A. Dresser Rd., at $99,000. G. T. Miller, Lebanon, award. contr. for 2.39 mi. A. E. Werkhoff Rd., Fairfield Twp., at $118,887.

Ind., Princeton—Geo. Sallee, City, award. contr. for construct'g stone rd. in Gibson Co., at $19,386.

Ind., Shelbyville—Sexton & Bolts, Shelbyville, and J. Harvey Snider, Fountaintown, award. contr. for two gravel rds., Shelby Co., at $9,596 and $12,250 respectively.

Ia., Mason City—E. J. Thraves & F. E. Hardin, Mason City, award. contr. to build 18 miles dirt road at Redwood Falls, Minn., at $62,000.

Mass., Chelsea—Coleman Bros., 1 Marginal St., Holyoke, low bidders for macad. rd., at Naval Hosp., at $24,260.

Md., Baltimore—P. Flanigan & Sons, Harford Rd., and B. & O. R. R., award. contract by City, for repairing sheet asph. & bitum. streets during 1918, at $81,145.

Mich., Lapeer—A. H. McMullen, Attica, award. contr. for rd. in Hadley Twp., Lapeer Co., at $17,888.

Mich., Reed City—J. E. Kissinger, Ashton, award. contr. for rd. constr. in Lincoln Twp., at $30,000.

Minn., Duluth—Victor Constr. Co. award. contr. for county rd. work at $5,366 and $9,924.

Minn., New Ulm—Thos. Peterson, Cobden, award. contr. for grading in Brown Co., at $880.

Miss., Woodville—B. H. Bass, City, award. contr. for improv'g several rds., at $20,000.

Mo., Jefferson City—Pope Constr. Co. & L. Brunner, award. contracts for improv'g roads, at $17,563.

Mont., Billings—Warren Constr. Co., City, award. contr. for paving Lewis Ave. with bithu., at $49,227.

N. J., Atlantic City—Sutton & Corson Co., 739 Asbury St., award. contr. for filling, grading, curbing and graveling portions Abrecon Blvd. and Venice Ave., at $97,917.

N. J., Cape May—Cassidy & Homan, City, award. contr. for construct'g road betw. Cold Spring Harbor and Wildwood Crest, at $84,879.

N. J., Newark—Newark Paving Co., 133 First St., City, award. contr. for improving Concord Ave., at $119,800.

N. Y., Bronx Borough—Standard Cont'g Co., 827 E. 217th St., City, award. contract for regulating, grading, setting curbs, lay'g walks and cross walks, bldg. inlets, receiv'g basins, drain culverts, etc., on 3rd Ave., E. 18th St. to Fordham Rd., at $52,807.

N. Y., Buffalo—Spire & Prior, Ellicott Sq., City, award. contr. for brk. paving on conc. fdn., Churchill St., at $6,999.

N. Y., New York—Davaney Asph. Co., Inc., 515 E. 17th St., City, award. contr. at abt. $25,000, for repaving several streets; Standard Contracting Co., 51 E. 42nd St., award. contr. for grading and improv'g 3rd Ave., at $52,800.

N. C., Charlotte—Porter & Boyd, City, award. contr. by War Dept., Washington, to construct 3 or 4 miles conc. rds. and 30 to 40 miles sewers, at $500,000.

N. C., Clinton—R. J. Hudson, Empire Bldg., Atlanta, Ga., award. contr. for asph. paving, at $50,000.

Ohio, Columbus—Following contracts award. by State Hwy. Comn. in various counties: Baker Constr. Co., Columbus, Sec. "Q," Columbus-Sandusky Rd., at $36,-156; Straw & Huber, Paulding, Sec. "A-1,"

KOLESCH SURVEYING INSTRUMENTS FOR SERVICE

Municipal Engineers!

We will gladly send you one of our instruments to test on your work without any obligation to purchase until it has proved its worth. **Kolesch Transits and Levels** are sturdy, accurate and moderate in price. Every detail has been studied to give an instrument that can be absolutely depended on for unvarying reliability and long life.

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NOW is the time to cash in with an "American" Truck Agency. The demand for our trucks will no doubt exceed our output this year, and this is particularly so of those trucks which will be used in hauling freight across the country.

To Distributors, Dealers and Salesmen in territories where we are not represented we will make very favorable contracts. You owe it to yourself to examine into the wonderful values found in **American Trucks.**

American Trucks are scientifically standardized. Continental Motor, Sheldon Worm-Drive Axles, Covert Transmission, Stromberg Carburetor, Pierce Automobile Governor, Eisemann Magneto. Four speeds ahead! Full 33⅓% more flexibility than the ordinary three-speed truck. Gives the right speed for the bad road that must be covered in good time.

IMMEDIATE DELIVERIES ON THREE AND ONE-HALF TON CHASSIS

AMERICAN MOTOR TRUCK CO.
DETROIT, MICH.

Bellefontaine-Lima Rd., at $13,450; Gray Bros., Bowling Green, Sec. "K" and Sec. "H-2." Toledo-Napoleon Rd., at $85,802 and $72,935 respectively; Sec. "F," Barnesville-Woodfield Rd., to Wilson Constr. Co., at $30,263; A. G. Witte & Son, Elmore, Sec. "K-1," Toledo-Elmore Rd., at $24,333; Modern Constr. Co., Fremont, Sec. "E-1," Bowling Green-Port Clinton Rd., at $12,-106 and $7,333; and Sec. "A," Fremont-Oak Harbor Rd., at $13,734; Sec. "E," Fremont-Dort Clinton Rd., at $56,074, and Sec. "A-1," Upper Sandusky-Tiffin Rd., at $35,-938; Donn & Langenderfer, Toledo, contr. for Sec. "Q," Upper Sandusky-Bellevue Rd., at $29,590; L. R. McMichael, for Sec. "L," Galion-Bucyrus Rd., at $55,222.

O., Bucyrus—L. R. McMichael, Bucyrus, award. contr. by Crawford Co., for bldg. 1.79 mi. brk. rd. on conc. base, at $55,000.

O., Toledo—Gray Bros., Bowling Green, O., award contr. for 8.3 mi. Maumee-Waterville Hwy. constr., at $159,350.

O., Youngstown—Kelley & Mayer Co., local, award. contr. for paving three streets, at $57,794.

Okla., Sapulpa—Nolan Paving Co., local, award. contr. for paving in Dist. No. 37, at $38,430.

Ore., Astoria—J. H. Tillman, Portland, award. contr. for constr. of 3-mile hwy., at $70,240.

Ore., Coquillee—Dean & Brown, Marshfield, Ore., award. contr. for macadamizing portion Empire-Sunset Bay road, Empire to Tar Heel, at $15,400.

Pa., Erie—Wm. Spento, Binghamton, N. Y., award. contr. for rein.-conc. constr. on 3 miles Harbor Crk. Twp. rd., at $64,000; Jos. McCormick & Son, Erie, Pa., award. contr. for 15,500 ft. westwardly on Ridge Rd. to point west of Asbury chapel, at $78,-395.

Pa., Harrisburg—Jos. McCormick & Bro., Erie, award. contr. for constr. of sec. State Hwy. No. 272, 13,750 ft., at $76,395; Frank Stento, Binghamton, N. Y., award. contr. for construct'g sec. on State Hwy. Route No. 87, 15,058 ft., at $64,478.

Pa., New Kensington—State Constr. Co., Parnassus, award. contr. for resurfacing 4th Ave., at $2.40 per sq. yd. (12,000 sq. yds. ½-in. cement-sand mortar bed on old brk. base). Young Road Builders Co., 925 Farmers Bank Bldg., Pittsburgh, award. contr. for furnishing asphalt blks.

S. C., Columbia—R. M. Hudson, Empire Bldg., Atlanta, Ga., award. contr. for construct'g 1.5 mi. asph. pav'g at Camp Jackson, at $40,000.

S. C., York—York county will build 3 miles 6-ft. conc. rd. by convict labor. Est. cost, $36,000.

Tenn., Benton—H. B. Hoppendietzel Co., Georgia Casualty Bldg., Macon, Ga., award. contr. for construct'g rd. around Little Frog mtn., at about $40,000.

Tenn., Greenville—Mann Constr. Co., Knoxville, award. contr. for grading approx. 175 mi. earth rds., and macadamiz'g 147 mi. in Greene Co., at $510,000.

Tex., Crosbyton—Sidney Webb, Bellevue, award. contr. for 22.66 mi. rds., Crosby Co., at $46,026.

Tex., El Paso—El Paso Bithu. Co., El Paso, award. contr. to repair, reconstruct and resurface El Paso-Ysleta Rd., at $180,000.

Tex., Galveston—Sam Fridner, Galveston, award. contr. to improve 5½ mi. of Hwy. No. 2, at $20,274.

Tex., Houston—Horton & Horton, Houston, award. contr. by War Dept., for laying tarvia pavement on all main roads in camp, at $100,000. This firm also has contract for all construction work to be done at Camp Logan, total est., includ'g above road wk., $538,000.

Va., Norfolk—J. U. Addenbrook's Sons, City, award. contr. to build conc. road over Govt. right-of-way to Pig Point Ord. Depot site, 1½ mile hwy., 18 ft. wide, at abt. $150,000.

Wash., Everett—H. S. Wright, City, award. contr. by Snohomish Co., for bldg. perm. hwy. No. 32, at $28,448.

Wash., Olympia—T. Peterson, Eatonville, award. contr. by State Hwy. Dept., for bldg. National Park Hwy., Pierce Co., from Sta. 1235 to Sta. 1495, at $41,745.

Wash., Pasco—Porter & Conley, Portland, Ore., award. contr. for grading and gravel'g 7 mi. hwy., at $28,845.

Wash., Prosser—O. S. Brown, City, award. contr. for macadamizing 7th St. and street leading into it, at $10,930.

Wash., Seattle—Superior Constr. Co., 131 Nob Hill, City, award. contr. for paving Utah Ave., at $46,416.

Wash., Seattle—Torger Peterson, Eatonville, Wash., award. contr. for grading and gravel surfacing portion of National Park Hwy., north of Chop, at $41,745.

Wash., Spokane—Standard Asph. Co., award. contr. for grading, paving and sidewalking Mallon Ave., Monroe to Howard St., at $31,013.

Wash., Yakima—Wash. Paving Co., Seattle, award. contr. for paving N. 1st Ave., bitum. surf. with conc. base, at $60,761.

SEWERAGE AND SEWAGE TREATMENT

Ala., Anniston—H. N. Bowdry, Birmingham, award. contr. for constr. of san. sewer sys. in W. Anniston, at $12,300.

Ariz., Tucson—A. W. Roberts, Tucson, award. contr. for construct'g rein.-conc. storm drain, conc. catch basins; also conc. wall and apron in Sixth Ave., at $3,600.

Cal., Calexico—G. R. Daley, local, award. contr. for street improvements has sublet contr. for construction of san. sewers to Bush Constr. Co., at abt. $18,000.

Cal., Long Beach—J. Wost, 2152 Reservoir St., Los Angeles, award. contr. for bldg. 27,500 lin. ft. cement pipe sewers, etc., in Sewer Dist. No. 7, at $31,487.

Fla., Tampa—Mabry & Owens, City, award. contr. for constructing storm drain at Spanishtown Crk. and along Platt St. Appropriation for drain, $8,500.

Ida., Rupert—B. M. Barsden & Co., Butte, award. contr. for sewer constr. in Dist. No. 1, at $82,000.

Ill., Normal—Foley Constr. Co., 127 N. Dearborn St., Chicago, award. contract for sewer constr., at $16,700.

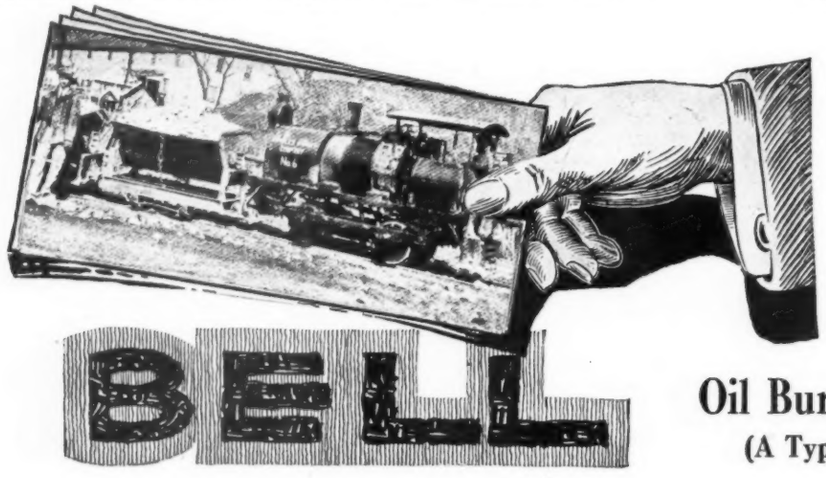
Ind., Mich. City—Jas. Gamble, Gary, award. contr. for sewer constr. in Dist. No. 1, at $5,200.

Ia., Marcus—Comstock & Hanson, Cedar Rapids, award. contr. for laying sewers at $23,937. M. Tschliger, Cedar Rapids, award. contr. for septic tank, at $10,995.

Ia., Mason City—S. R. Bowen & Co., City, award. contr. for laying 2 san. sewers, at $2,000.

Kans., Hutchinson—H. G. Shears & Sons, Hutchinson, award. contr. for sewer improvs., at $87,000.

Mich., Detroit—Wolverine Engr. & Constr. Co., City, award. contr. for lat. sewer No. 3042, at $4,980; Jos. M. Affeld, sewer No. 2935, at $2,405; No. 3039, at $7,961; No. 3040, at $13,501; Western Constr. Co., contr.



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Laurin & Leitch Engineering and Const. Co., Ltd., Montreal, Can.

Any handy workman of average ability can operate and care for a **Bell Locomotive.** Low center of gravity permits of high speed over uneven tracks.

Can be fired up and ready for operation in a few minutes. No hand oiling. One valve fire control. In sizes from 2 to 18 tons. Lowest in price.

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30 Church Street **(Founded 1908)** **NEW YORK CITY.**

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The one thing that we never try to afford is a dissatisfied customer.

That is why we make "Double Duty" Fire Apparatus! It stands well with the men who are responsible for pleasing the public—it gives such Doubly Dependable Service that cities recognize the influence and prestige of the name *South Bend "Double Duty."*

We place that name *"Double Duty"* on our apparatus as a pledge of good faith and better machinery; it is a promise that the fire apparatus bearing it is under bond to give you satisfaction—and it does. We are not only selling you South Bend Fire Apparatus but "Double Duty" Service—and we see that you get it!

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WALTER M. HELLER, 142 Market St., Newark, N. J.

SOUTH BEND MOTOR CAR WORKS
SOUTH BEND, IND.

for No. 2822, at $5,315; No. 3037, at $25,860; J. A. Mercier, No. 3043, at $10,700; Wm. Porath, Nos. 3029, 3031, 3039, at $7,365, $4,564 and $12,391 respectively! Roy D. Baker, No. 3030, at $10,827.

Mich., Detroit—Jeynes & Affeld, 1208 Ford Bldg., award. contr. for bldg. sewer in Linwood Ave., at $279,453; W. Blanck Co., contr. for sewer in Davison Ave., at $26,-270.

Minn., St. Paul—E. T. Webster, City, award. contr. for construct'g sewer on Stanford Ave., and on Parcel Ave., at $5,653.

Minn., Windom—Wm. Neuman, Lakefield, award. contr. for laying 22,000 ft. tile drains, at $7,200.

Mo., Kansas City—Donnigan & Briggs, Shenandoah, Ia., award. contr. for bldg. sewerage sys. in joint sewer dist., at $80,-636.

Mo., St. Joseph—Skillbred Constr. Co., City, award. contr. for sewer construc., at $4,528.

Mont., Terry—Security Bridge Co., Billings, award. contr. for constructing san. sewer system, at $3,985.

Neb., Aurora—Peterson & Schreiber, Omaha, award. contr. for construct'g septic tank, at $5,790.

Neb., Omaha—J. F. Harrington, 3001 Mason St., City, award. contr. for bldg. sewer in Dist. No. 364, at $18,315.

Neb., Omaha—E. P. Donahue, 306 Lincoln Blvd., award. contr. for sewer construc. in Dist. No. 608, at $20,311; A. F. Hanse, 4701 Franklin St., sewer, at $3,347; Hans Willadsen, storm sewer No. 359, at $3,347, and J. F. Harrington, Topeka, Kans., No. 364, at $18,315.

N. J., Westfield—Ralph F. Relly, 248 Somerset St., Plainfield, award. contr. for construct'g approx. 1,950 lin. ft. 8-in. san. sewer and appurts., in Columbus, Grandview Aves. and Seneca Pl. and Pine St., at $4,537.

N. Y., New York—J. Pilkington Co., 96th St. and 1st Ave., City, award. contr. for sewer and pumping sta. in Canal St., at $212,000.

N. C., Charlotte—Porter & Boyd, Charlotte, award. contr. by War Dept. for construct'g 30 to 40 miles of sewers and 3 or 4 mi. conc. rds., at abt. $500,000.

N. D., Wilton—Jas. Kennedy, City, award. contr. for construct'g 2,005 lin. ft. 12-in., 4,747 lin. ft. 10-in., 4,506 lin. ft. 8-in. vit. sewer pipe, etc., at $18,968.

O., Cleveland—Paul Ciraci, award. contr. for sewer in E. 125th St., at $4,500; and sewer in E. 120th St., at $4,900.

O., Cleveland—Sprague & Burkhardt, local, award. contr. for sewer in Hamilton Ave., N. E., 23rd to 4th St., at $4,600.

O., Elyria—Granger & Ingleton, City, award. contr. for sewer constr. in Filbert St., at $2,438.

O., Youngstown—Turner Constr. Co., Mahoning Bk. Bldg., No. 1, City, award. contr. for bldg. Mill Creek Park Dist. sewer, at $131,108. Frank George, 1567 Mahoning Ave., contr. for Sec. No. 2, at $103,448.

Okla., Miami—J. T. Lantry, 303 Bk. of Com. Bldg., Tulsa, award. contr. for bldg. sewerage and water sys., at $29,022.

Okla., Tulsa—C. Pleasant, Ia. City, award. contr. for lay'g 7,200 ft. 24-in. c. i. pipe, at $14,995.

Pa., Erie—Cantrell Co., 30th and Walnut Sts., Philadelphia, award. contr. for Mill Crk. Improvt., at abt. $975,000.

Pa., Pittsburgh—P. D. Thomas Co., 6 Boundary St., City, award. contr. for sewer constr.; F. & F. Duillius, 40 Boundary St., and Manella Constr. Co., 1509 Lang Ave., also award. contrs. for sewer constr., abt. $18,000.

S. D., Lake Andes—Jas. J. Orr, Yankton, award. contr. for sewer sys., at $24,500.

Tex., Houston—Houston Constr. Co., City, award. contr. for construction of 3 sewers, at $5,000.

Tex., San Antonio—McKenzie Construction Co., City, award. contr. by Southwestern Insane Asylum for construction of sewage disposal plant; Imhoff tank, sludge bed and sprinkling filter, at $12,000.

Tex., San Antonio—Young & Ramsey, 306 King William St., City, award. contract for constr. of san. sewers in New Braunfels Ave. and E. Houston St., at $25,000.

Wash., Olympia—D. E. Werts, City, award. contr. for sewer construc. in alley betw. Sherman and Faragut Aves., at $72,912.

Wash., Waitsburg—C. H. Sutherland, Walla Walla, award. contr. for bldg. 11 mi. conc. or vit. sewer pipe line, at $34,577.

Silence is no longer Patriotism!

Silence is the effect of pro-Germanism, for it is just what the pro-German would ask in order that America's mistakes might *not* be corrected or her Full Strength Mobilized.

Every industry that provides employment and War Revenues is an *essential* industry, and to destroy it is to invite the soup kitchen. It is a part of patriotism to see that every American plant is *kept going* as prosperously as possible. It is the part of patriotism to see that we have the *money* to do our full share in subscribing for the Government War Bonds.

WATER SUPPLY AND PURIFICATION

Ariz., Navajo Ind. Sch.—R. F. Yoder, Gallup, N. Mex., award. contr. for constructing addn. to water sys., at $16,000.

Cal., Delano—L. E. Prestage, Porterville, award. contr. for drilling 14 and 16 in. wells for new municip. water plant; $40,000 bonds voted for this work.

Cal., El Centro—Blee & Sears, 1947 Mateon St., Los Angeles, award. contr. for construc. of water filtration plant for municipal water sys., at $164,000.

Cal., San Pedro—Thos. Haverty Co., Los Angeles, award. contr. for construc. of water sys., at $12,300.

Cal., Tracy—O'Brien Bros., San Francisco, award. contr. for construct'g 1,650 ft. rein.-conc. discharge pipes, at $18,627.

Fla., Key West—Williams-Gerstle Engr'g Co., New York City, award. contract for construct'g conc. tower and tank at biological sta., at $4,737.

Fla., Pensacola—Layne & Bowler Co., City, award. contr. for digging wells and install'g pumping machinery at Navy Aeronautic Sta., at $17,000.

Ia., Sioux City—Harris Air Pump Co., Chicago, award. contr. for air lift pumps, compressor, air receiver and condensor, at $22,232.

Kans., Eureka—J. S. Davis, local, award. contr. for improv'g water sys., at $6,630.

Minn., Franklin—Risberg & Marwick, Virginia, Minn., award. contr. for install'g water mains, at $23,119; C. A. Johnson, Virginia, award. contr. for two 50,000-gal. wooden water tanks on 100-ft. steel towers, at $14,300; Worthington Pump & Machinery Co., 613 Merchants Natl. Bank Bldg., St. Paul, award. contr. for three 50-gal. vert. single acting triplex pump and motors, at $4,380.

Neb., Aurora—Peterson & Schreiber, Omaha, award. contr. for septic tank to be installed at mouth of river, $5,790. Keystone Driller Co. also award. contr. for double stroke pump, at $2,392. Latter firm is located at 426 Monadnock Blk., Chicago.

Neb., Lincoln—John Mullin, Lincoln, award. contr. for concrete reservoir at pumping sta., at $14,240.

N. D., Wilton—W. D. Lovell, Minneapolis, Minn., award. contr. for constructing waterwks. in city, at $47,683.

Okla., Tulsa—C. Pleasant, City, Iowa Bldg., Tulsa, award. contr. for laying 7,200 ft. c. i. pipe, at abt. $15,000.

Pa., Philadelphia—Memphis Steel Constr. Co., Pittsburgh, award. contr. for construct'g elevat. steel tank and tower at navy yd., Phila., at $16,484.

Tex., Ft. Worth—Taylor Bldg. Co., City, award. contr. for construct'g retain'g walls, steam plant and water plant for new county jail, at $42,028.

Tex., Ft. Worth—Pittsburgh Filter Mfg. Co., Pittsburgh, Pa., award. contract for improvts. at filtration plant to include bldg. of basins, extensions of bldgs., install. of pipe galleries, at $67,300. Will ask bids within 10 days on sed. basins and chem. house. Jno. H. Gregory, Conslt. and design'g Engr., 170 Broadway, N. Y. City; J. C. Lord, Comr. waterwks.

Okla., Red Fork—W. E. Kerr, City Clk., will constr. waterwks. Contr. award. to Hughes Engr'g Co., 310 Bk. of Com. Bldg., Tulsa, at $18,000.

Tex., Waco—B. F. & C. E. Davis, Fort Worth, award. contr. for construct. of 5,000,000-gal. reservoir, at $50,857.

Wash., Waitsburg—G. H. Sutherland Co., Walla Walla, award. contr. for construction of waterworks sys., at $34,577.

Okla., Red Forks—Trinity Constr. Co., Dallas, Tex., award. contr. for bldg. water system, at $17,209.

BRIDGES AND BUILDINGS

Cal., Eureka—Mercer-Fraser Co., City, award. contr. by Humboldt Co., for bldg. 500-ft. span cable suspension hwy. brdg., with 75-ft. truss brdg. approach each side, in Rd. Dist. No. 2, at $76,582.

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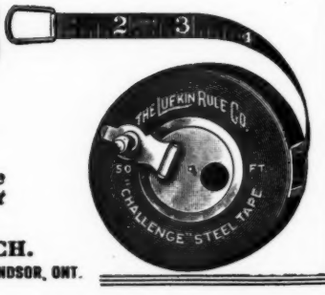

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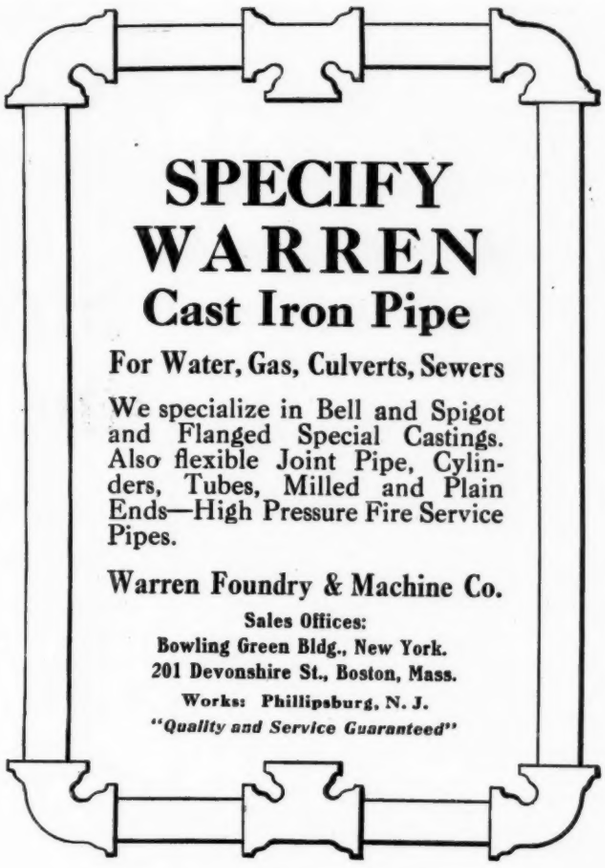

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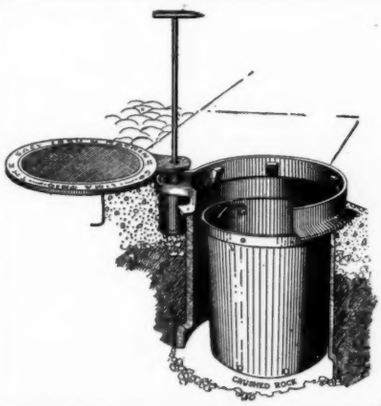

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Makers of Merriman Steam Melting Asphalt Plants.

Cal., Modesto—C. E. Cotton, 16 California St., San Francisco, award. contr. for 4 conc. flat slab bridges, etc., at $16,720.

Cal., Santa Rosa—Walter L. Proctor, City, award. contr. by Sonoma Co., for constr. of 2 bridges, one across Copeland's Crk., at $2,768, the other near Wilfred Sta., at $2,184.

D. C., Washington—J. Eichleay Co., Jr., S. 20th and Wharton Sts., City, award. contr. for steel wk. on military brdgs. at engineering depot, at $12,940.

Ill., Dundee—Oltendorf Constr. Co., local, award. contr. for construct'g Main street bridge, at $42,795.

Ill., Springfield — Zibberly Brdg. Co., award. contract for O'Hair Co. line brdg., at $5,539; for Fitzgerald brdg., at $2,619, and Jenkins brdg., at $1,495.

Ia., Atlantic—Lana Constr. Co., Council Bluffs, award. contr. for corrugated and rein.-conc. culverts in Cass Co., at $5,972.

Ia., Dyersville—Staner-Herkes Co., Dubuque, award. contr. for construc. of a conc. bridge in center of Dyersville, at $27,994.

Ia., Ft. Dodge—Royce & Slater, Stratford, award. contr. for rein.-conc. and steel brdgs. and culverts, at $11,995; J. J. Cain, Claire, $7,350; S. Swanson, Webster City, $7,296; Knobb & Locke, Humboldt, $2,263.

Ia., Nevada—Cole Bros., Nevada, award. contr. for 53 bridges and culverts to be constructed in Story Co., at $31,000.

Kan., Kans. City—Ark. Brdg. Co., Waldheim Bldg., Kans. City, Mo., award. contr. for Central Ave. viaduct approach, at abt. $190,000. E. J. Watterstram, 1117 Rialto Bldg., Kans. City, Mo., award. contr. by City for Union Pacific portion of James St. steel and rein.-conc. viaduct, 1,500 ft. long.

Me., Trenton—Otto Nelson, 194 Exchange St., Bangor, award. contr. for brdg. constr., at $21,000.

Minn., Minneapolis—W. S. Hewett, Minneapolis, award. contr. for erec. of brdg. over Miss. River at Palisade, at $9,673.

Minn., Palisade—W. S. Hewitt, Minneapolis, award. contr. for constructing brdg. over Mississippi River, at $9,673.

Minn., St. Paul—Fielding & Shepley, City, award. contr. for constr. of Center Pier Protec., at Marshall Ave. brdg., at $18,200.

Mo., Warrensburg—Western Brdg. Co., Harrisonville, award. contr. for construct'g 9 steel brdgs., at $14,500.

Neb., Center—Western Brdg. & Constr. Co., Omaha, Neb., award. contr. for construct'g brdg. across Verdigree River, at $14,585.

Neb., Gering—Omaha Struc. Steel Co., award. contr. for 2 rein.-conc. brdgs., at $24,000 each.

Neb., Scottsbluff—Omaha Struc. Steel Wks., 48th & Leavenworth Sts., Omaha, award. contr. for rein.-conc. brdg. across N. Platte River near Mitchell, at $41,300; and brdg. across N. Platte River near here, at $41,300.

N. J., Jersey City—Bethlehem Steel Co., award. contr. for repair'g Passaic bridge, at $17,000.

N. Y., Rochester—Seneca Eng. Co., Montour Falls, award. contr. for bldg. Clarissa St. brdg. over Genesee Riv., at $258,700. Brdg. is 1,000 ft. long, and 90 ft. wide.

N. Y., Troy—Horseheads Constr. Co., Horseheads, award. contr. for repairing 12th St. brdg. over Hudson River, Ont. St., Cohoes and 12th St., Lansingburg, Troy, at $53,259.

S. D., De Smet—Carl Schultz, local, award. contr. for 3 bridges on Red Stone Creek, at $9,160.

S. D., Plankinton—Mike Gales, local, award. contr. for 1 I-beam steel brdg., at $2,120; 1 32-ft. I-beam steel brdg., at $2,120; 1 20-ft. I-beam steel brdg., at $17,770; 1 20-ft. I-beam steel brdg., at $1,770.

O., Youngstown—C. M. Neeld Constr. Co., Pittsburgh, award. contr. for construct'g Cedar St. brdg., at $46,000.

Okla., Pawhuska—Missouri Valley Brdg. & Iron Co., Leavenworth, award. contract for 3 bridges, at $7,720, $4,560 and $1,435 respectively.

Okla., Wilburton—Broadman Co., Okla. City, award. contr. to construct brdgs. across Bear, Rock, Red Oak & Turkey Crks., at $13,850.

Pa., Philadelphia—Jno. S. Bailey, Doylestown, award. contr. for bldg. conc. brdg., at Hulmeville, at $41,400.

Va., Norfolk — Porter Bros., Spokane, Wash., award. contr. by War Dept., to erect warehouses, barracks, etc., construct docks and piers (strucs. abt. 160 ft. wide and 12 ft. high, 200 to 2,000 ft. long), conc. doors, tile or conc. walls, metal roofs, conc. pavements, etc. A. O. Leach, Supvr. Engr., Withers Bldg., city, will expend $16,000,000 for these two term. imprvts. Ultimate expend. est. at $30,000,000 to $40,000,000.

Use Your Influence

Strangling the Periodicals

Congress at its last session passed a hasty postal law increasing the postage on periodicals from fifty to nine hundred per cent. Some periodicals will be killed—all will be restricted in circulation and crippled. There will be fewer readers, and the habit of reading curtailed.

To shut out Farm Journals—as these zone rates will—will lessen the productive power of our country by millions of dollars through loss of better methods. Shut off Trade Journals and you decrease the manufacturing power by more millions.

Shut off the religious papers and there are shut off channels that have raised millions of dollars for distressed humanity. Shut off the great periodicals of the home and there is throttled an avenue that has given expert instruction to hundreds of thousands.

Small towns and distant districts depend to a large extent upon periodicals; thus this law increasing periodical postage where it is most needed shuts off opportunity where needed. It penalizes periodical readers.

Repeal this fifty to nine hundred per cent periodical postage increase. Write your Congressman.

Use Your Influence

Va., Richmond—Weinbrunn & Kelley, City, award. contr. to construct rein.-conc. viaduct and retain'g walls on line of Chamberlayne Ave. Pkway., at $78,000.

Wash., Everett—H. S. Wright, City, award. contr. for replanking, placing new stringers, necessary piling and raising Home Acres trestle, at $23,440.

Wash., Everett—Coast Bridge Co., Portland, Ore., award. contr. for construction of steel bridges at Index and Granite Falls, at $25,000.

Wash., Seattle—Hans Pederson, City, award. contr. for constr. of rein.-conc. brdg. across Nisqually River near La Grand, at $47,719.

W. Va., Fairmont—Jno. F. Casey Co., award. contr. on cost plus and percen. basis for constr. of brdg. over Monongahela River., abt. $500,000.

Wis., Eau Claire—Cast Stone Constr. Co., award. contr. for erec. of Co. aid bridge over Chippewa river at Cobhan, at $12,000.

Wis., Oakwood—Milwaukee Constr. Co., 857 8th Ave., Milwaukee, award. contract for 2 conc. brdgs., 1 112-ft., at $10,700; 1 35-ft., at $2,700.

Wis., Sheboygan—Wausau Iron & Brdg. Co., Wausau, award. contr. for brdg. over Pigeon River, at $5,700.

PROSPECTIVE WORK

ROADS AND STREETS.

Ark., Ashdown—Little Riv. Co. Comrs. have plans by State Hwy. Dept., for 12-mile rd., Ashdown to Wilton. Est. cost, $73,890.

Ark., Ft. Smith—Plans under way for construct'g 72 miles of hwy. in Yell County. Logan Co. now organizing district to extend hwy. westward and connect with this county in vicinity of Washburn.

Ark., Little Rock—Plans sent out by State Hwy. Dept. for 22-mi. rd. in Logan Co. Est. cost, $118,936, native crushed stone to be used.

Cal., Los Angeles—Plans under way for construc. of scenic road up Mt. Washington.

Cal., Los Angeles—Monster petition presented to Council for opening of abt. 20 blks. betw. Washington and Santa Barbara St. on Hill. City Council has also given formal assurance of early opening of Broadway betw. Pico and Washington Sts.

Cal., Los Angeles—Influential lumber and other business men have filed petition with City Council for conc. blvd. to mainland at Wilmington from Term Island. They request rd. with two laterals; one connect'g. with Anaheim Rd. to Long Beach, the other with Fish Harbor.

Cal., Merced—Fed. Rd. Engr. will make survey of county's rds., in connection with movement for $1,250,000 bond election.

Cal., San Diego—Appropriation of $373,000 for completion of paved hwy. to connect San Diego and El Centro, approved by Sec'y Houston of Dept. of Agri. State has appropriated $750,000 for this work.

Colo., Denver—One million eight hundred thousand dollars will be expended for highway construction in state during 1918.

Colo., Denver—140 miles of roads (six projects) will be constructed during 1918; first will be finishing 4 mi. rd. betw. Denver & Littleton; 2nd, 50 mi., betw. Lamar, Prowers Co., and Springfield, Baca Co.; 3rd, 42 mi. Rifle to Meeker, Garfield and Rio Blanco Cos.; 4th, 3 mi., Placerville to Norwood, San Miguel Co.; 5th, 26 mi., Norwood to Naturita thru Paradox Valley; 6th, 17½ mi., Meeker to Craig, Blanco and Moffatt Cos. In addn. 2 other projects have been submitted for approval to Washington, one for work on 26 mile stretch known as main north and south hwy. from Pueblo Co. line to southern state line; the other, for completion of Granite-Twin Lakes project, 12 mi. in Lake & Chaffee Counties.

Fla., Pensacola—$3.585,000 road bonds voted by 14 counties thruout state.

Ga., Atlanta—$400,000 appropriation for road building will include following roads: Atlanta to Alpharetta; Dixie Hwy., Atlanta towards Rome; Dalton and Chattanooga; Bankhead Hwy. and rd. thru Cherokee, Pickens, etc., road, Columbus to Savannah, thru Charlton Co., etc., may also be considered under this allotment.

Ga., Atlanta—M. L. Collier, Chf. of Constr. planning to start at once paving E. Hunter, Severne, Stewart Ave., Bedford Pl., Latham St., S. Pryor, So. Blvd., No. Blvd., W. Fair, W. Alabama and Lee Sts. County will be asked to share in paying expense of repaving Peachtree, Whitehall and other thorofares.

Idaho, Boise—Plans prepared for hwy. from Grangeville to New Meadows. Est. cost, $800,000, to be shared betw. State and Fed. Govt.

Ill., Chicago—Cook County is planning to build 50 miles paved hwy. during 1918. This is in addn. to completing 41 miles unfinished work. Following roads included: Chicago-Milwaukee (7 mi.); Chicago-Ottawa-Springfield Rd. (12 mi.); Homewood-Lansing (7 mi.); Lincoln Hwy. (9 mi.); Desplaines River Rd. (15 mi.).

Ill., Chicago—City contemplates extending Ogden Ave., Union Park to Lincoln Park. City Council Home Def. Comm. approves plans and requests that Finance Comm. provide appropriation $35,000 to carry out engineering and investigating phases of work.

Ind., Crown Point—Plans under way for paving Lincoln Hwy. thru Lake Co., 16 miles, with 18-ft. conc., strong enough to bear weight of artillery and war vehicles.

Ind., Mt. Vernon—$6[illegible],000 appropriation made by Co. Comrs., Jennings Co., for construct'g 24 miles of east and west market hwy. State will appropriate like amt. Addn. appropriation to be made later by Co. Bd. to complete hwy. thru Co. Est., $200,000.

Ia., Des Moines—$4,000,000 will be available for building 75 miles on Jefferson Hwy.

Kans., Lawrence—Petitions being signed for construction of 29½ miles rock rds. in Leavenworth and Wyandotte Counties, to

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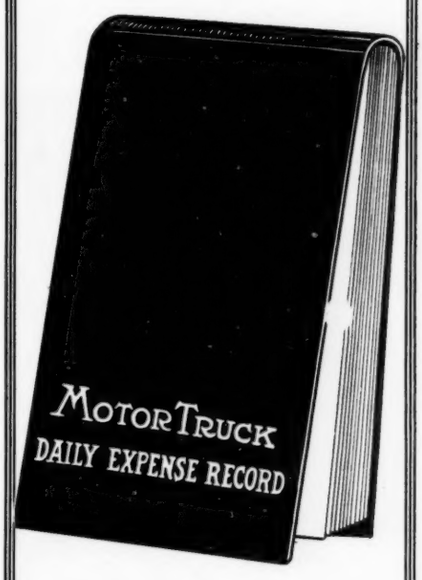

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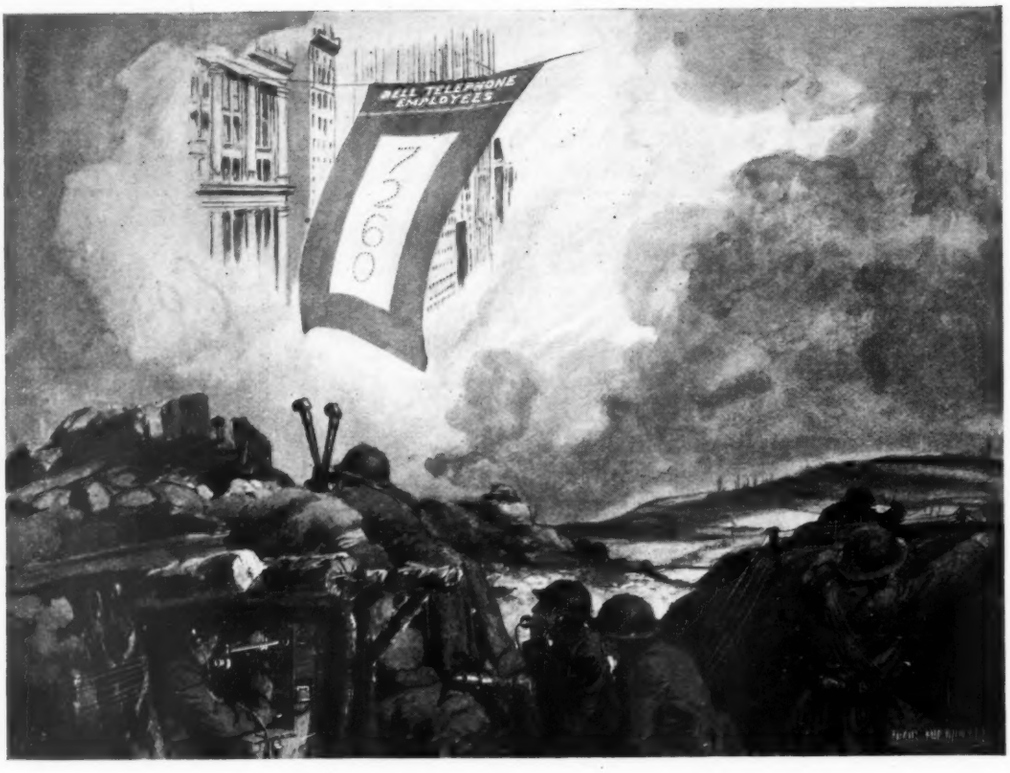

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Kans., Topeka—Three and one-quarter million dollars to be expended by state of Kansas for following improvements: 11.25 mi. conc. rd., 16 ft. wide, in Mitchell Co.; 18.34 mi. conc. rd., 18 ft., Douglas Co.; 8.25 mi. conc. rd., 16 ft., Cloud Co.; 10 mi. conc. rd., 18 ft., Shawnee Co.; abt. 20 mi. conc. rd., 18 ft., Leavenworth Co.; 8 mi. conc. rd., 18 ft., Sedgwick Co.; 27½-mi. brk. rd., 20 ft., Barton Co.; 44.45 mi. gravel rd., 16 ft. Bourbon-Labette Co.; abt. 35 mi. macad. rd., 14 ft., Bourbon Co. Seven million dollars addn. available for maintenance and constr. twy. rds. and bridges. W. S. Gearhart, State Hwy. Engineer.

L. I., Riverhead—Suffolk County (in connection with state) will build boulevard around Long Island. 95 mi. conc. rd. planned. Est. cost, $2,000,000, Suffolk County contributing abt. $640,000 as its share of expense.

La., New Orleans—$200,000 Fed. aid for this state for road building. Funds to be spent as follows: Richland Parish, $40,000; Ascension, $40,000; Point Coupee, $40,000; Rapids, $60,000, and Lincoln, $15,000. 233 miles of roads outlined in state. Work will be pushed on same as rapidly as possible.

Mich., Detroit—City Plan Comn. directed to prepare plans and cost ests. for 80-ft. street east and west across city. Kercheval Ave. to be used for eastern part. Improvt. will start at Mt. Elliott Ave., which will be widened betw. Kercheval and Waterloo; latter street to be widened and straightened entire length and connected with High which, in turn, will be made an 80-ft. thorofare. Est. cost, $500,000.

Mich., Detroit—Plans under way to improve 3¼ miles along Lake Shore Dr. to Mt. Clemens; Gratiot Ave. Rd., 10 miles long, also to be paved.

Minn., Little Falls—$50,000 Fed. aid for hwy. from Benton Co. line to Crow Wing county line (equal amt. to be spent by county); also state rd. from Swanville to Pierz. Total mileage of both, 82 miles. Abt. $137,000 will be expended on road improvements.

Minn., Mankato—$8,000,000 will be expended on state and county road improvements during 1918. C. M. Babcock, Commr. of Hwys.

Minn., St. Paul—This state will expend about $7,700,000 on road constr. and maintenance during 1918. C. M. Babcock, Commr. of Hwys.

Minn., St. Paul—Jefferson Hwy., as far south from city as Westcott, will be paved. Dakota County will give $30,000 from So. St. Paul down; State, $35,000, and Govt., $34,000. Road will be conc., 20 ft. wide.

Mo., Kans. City—$1,250,000 available Apr. 1st for road construction in this state. Governor Gardner declares state will give dollar for dollar for all money voted by counties for bldg. state roads.

Mo., Liberty—$1,250,000 rd. bonds voted by Clay County Court, 202 mi. of roads.

Mont., Bozeman—Hwy. up West Gallatin Canyon now assured. State Hwy. Comn. and forestry officials approve proposition. Est. cost, $140,000. Govt. will pay half expense where rd. is in Nat'l Forest, provided counties will bear other 50 per cent.

Mont., Butte—About $305,000 will be expended to repair two main hwys. spanning Bitter Root mountains. Robt. S. Phillips, Sec'y Butte Auto Club, interested.

Mont., Great Falls—State Engr. Paul B. Pratt announces that three quarters of a million dollars will be expended on highways during 1918. Preliminary surveys already made on Fed. aid projects in Casoade, Park, Wibaux, Dawson, Madison, Lewis, Clark, Gallatin, Breedwater, Carbin and Big Horn Cos.

Mont., Helena—About $1,000,000 to be expended by counties for road improvements; state hwy. comn. will expend $750,000; Fed. aid, $300,000.

Mont., Missoula—Missoula County considering 40 miles of paving, Bozeman to Yellowstone Park. Est. cost, $140,000; abt. $70,000 Fed. aid. W. J. Babington, Co. Clk.

Mont., Missoula—This state will receive $71,064 Fed. aid for road bldg. Total of $142,000 will be available for highway work this year.

Nev., Reno—Municipal budget amounting to $190,000, ratified by Council. $40,000 will be spent in general street improvements.

Nev., Reno—New stretch of rd. through Wilson's Canyon along W. Walker River (4 mi.), will be constructed by Nev. Hwy. Bd., this spring. Bd. will work in co-operation with residents of Mason & Smith valleys, Lyon Co., and Nev. Copper Belt R. R.

N. J., E. Orange—City Plan Comm. has recommended to Council widening of Springdale Ave., and eight cross streets, extension of 10 others and opening of one new highway south from Central Ave.

N. J., Mt. Holly—$196,000 available for rd. work in Burlington Co. Jas. Logan, Co. Engr.

N. J., Paterson—Plans under way for bldg. stretch of rd. from Fort Lee Ferry to Anderson Ave., in Bergen Co., by State Hwy. Comm. Est. cost $170,000. While this rdway will be shortest in year's program, it will be most difficult to construct; part of cliff will have to be cut away and heavy retaining walls constructed; will also be made sufficiently wide to accomodate large motor truck traffic.

N. J., Trenton—A total of $2,871,000 will be expended in various hwy. betterment projects—from Fort Lee, in Bergen, to Cape May City in county of same name. Gen. Goethals also recommends improvement of route No. 9—Phillipsburg to Elizabeth—to give direct outlet centres to Newark, Jersey City and New York.

N. J., Trenton—White Horsepike to be improved south of Berlin as far as appropriation of $500,000 will carry work. Pavement to be conc., 20 ft. wide.

N. M., Santa Fe—State Hwy. Comm. has approved fed. aid projects for road construction amounting to $293,000. This includes Tesuque project, Santa Fe, 10 mi. Est. $50,000; Armijo-Vallejos project, Valencia Co., 28 mi. Approx. $81,000; Alamogordo-Valmont proj., Otero Co., 10 mi.—$23,300; 12 mile conc. rd. south from Las Cruces, $139,000.

N. Y., Buffalo—Council Comm. approves issuance of $1,670,000 bonds for improvements this spring. Included are new viaducts, Hamburg turnpike ($45,000), viaduct reconstr., grade crossing, ($230,000), Bird Island Pier Improvement, $100,000), etc. etc.

N. Y., Rochester—City planning to pave Main St. E., with asphalt block at cost of $109,000. C. Arthur Poole, City Engr.

O., Cleveland—City considering project to make Prospect Ave. S. E. from E. 9th St., to E. 40th St., a part of city's blvd. sys. Plans and cost est. to be submitted by City Engr. Hoffman.

O., Columbus—State Hwy. Dept. has authorized construction of main market road in Highland Co.—part of proposed military rd. to connect Camp Sherman, Chillicothe and Cincinnati. Est. cost $380,000.

Pa., Harrisburg—State Hwy. Dept. considering reconstr. of Wm. Penn Hwy., Harrisburg to Reading—2 in. bitum. surf. on macad. or conc. fdn. Approx. cost. $900,000. J. D. O'Neill, State Hwy. Commr.

Pa., Harrisburg—Harrisburg-Reading rd. being selected as route for motor trk. mail delivery. hwy. will be rebuilt entire length —5½ miles.

Pa., Johnstown—$27,000 bonds have been sold by Conemaugh, Twp. Proceeds will be used for improv'g. rd. from Franklin Boro toward So. Fork., by brick paving on conc. base.

Pa., Philadelphia—As soon as weather permits street improvts. will begin. City plans expenditure of $1,000,000 for constructg. 'new sts., and improving old.

Pa., Pittsburgh—Recommendation made by E. K. Morse, Traffic Comr., for widening Second Ave., ($850,000); Grant St., ($1,000,000), Ferry St., ($300,000); improvg. Water St., ($80,000) and Duquesne Way ($113,000).

Pa., Reading—$155,000 appropriation for street and public improvements during 1918.

Pa., Wilkes-Barre—$500,000 appropriation for rd. bldg. made to State Hwy. Dept. by State Defense Comm.

Tenn., Nashville—Appropriation of $1,500,000 made by State Hwy. Dept. which will be used in co-operation with counties for hwy. constr. A. M. Nelson, Engr.

Tex., Dallas—Geo. A. Duren, State Hwy. Engr., has outlined rd. building program as follows: Meridian Hwy., by way of Ft. Worth, Waco, Temple, Taylor, Austin and San Antonio, starting at Wichita Falls; Meridian Hwy. by way of Bremond, Bryan, Navasota, Houston and Galveston; Texarkana-El Paso Hwy., which runs thru counties betw. Texarkana and Ft. Worth; Exall Hwy. from Denison by way Dallas, Ennis, Corsicana, Mexia, Groesbeck, Bryan, Navasota, Hempstead, Houston and Galveston. He urges these improvts. as absolute war necessity.

Tex., El Paso—City of Juarez planning to pave Comercio St. with bithulithic. Work to be started during month. As soon as this paving is completed, two sts., leading to El Paso—one to Santa Fe brdg.; the other to Stanton St. brdg. will be paved.

Tex., Jourdantown—Puget Sound to Gulf Hwy. Dist. No. 4, (Atanco Co.) will build Puget Sound Hwy. through county; also improve tributary roads. Bonds to amt. of $250,000 voted.

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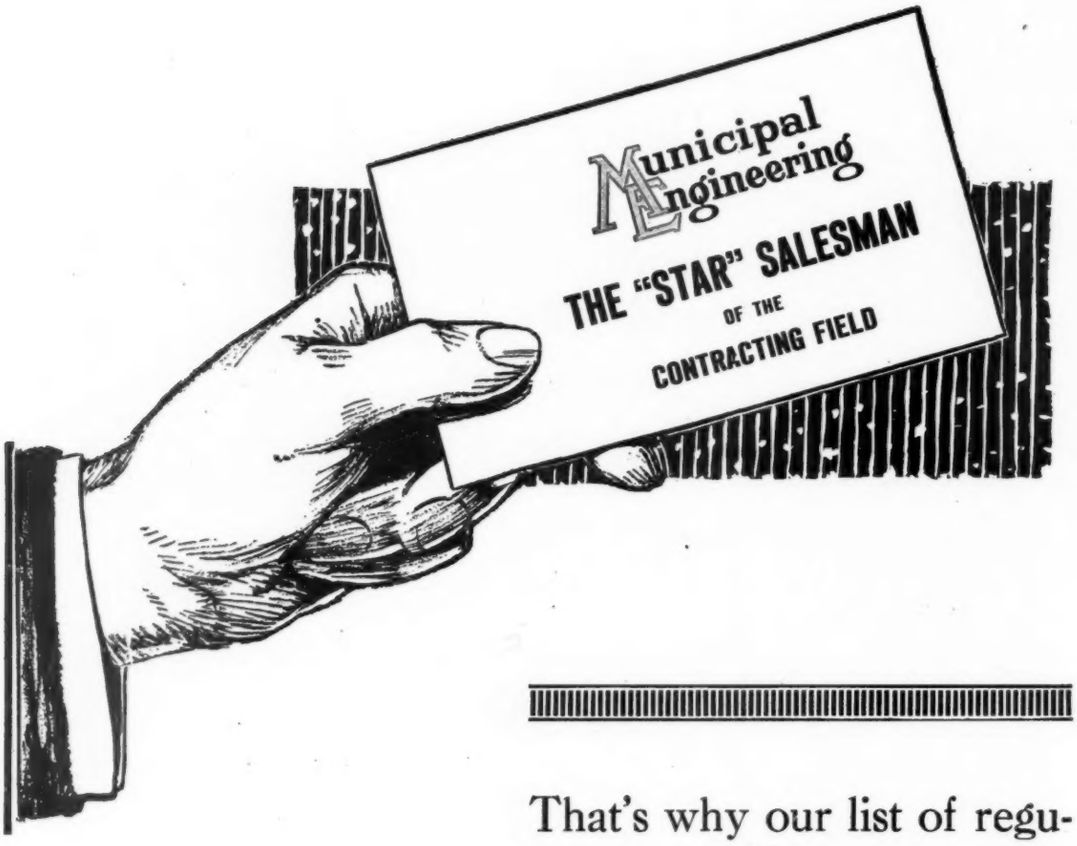

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Municipal Engineering

Tex., La Grange—$100,000 bonds voted for improvement of Houston-San Antonio Hwy.

Tex., Lockhart—$15,000 bonds voted by Mendoza Co., $200,000 by Lockhart Co., and $15,000 by Luling. Funds to be used on hwy., and tributary rds., leading into it from other sections of county.

Tex., Waco.—Young Men's Bus. League Directors considering good rds. campaign in McLennan Co. for purpose of obtaining approval of bond issue to amount of $2,500,000.

Wash., Olympia—North Pacific District (Oregon, Wash. and Alaska) will receive $272,422 fed. aid to build rds. and trails within or partly within the national forests. Oregon's share—$132,796; Washington's—$92,565; Alaska's—$47,061.

Wash., Olympia—Plans being prepared by State Hwy Comr. Allen for improvt. of 8 1-3 mi. of Sunset Hwy. betw. Creston and Wilbur. Bids to be asked next week by Comr. for surfacing 1¼ miles Pacific Hwy. betw. Toledo and Forest.

Wash., Seattle—Co. Engr. S. Humes has completed plans for 20 miles paved hwys. to be constructed this year. Approx. cost $350,000.

Wash., Spokane—Stevens Co. interested in proposition to build hwy. from here to British Columbia line. Est. cost $5,000 a mile. Road will probably run from Colville to Waneta, about 45 miles.

Wash., Spokane—Spokane County planning to construct 17 miles hwy. as follows: Resurfacing and paving 5 mi. Sunset Hwy.; Cheney Normal Rd., 3 mi. resurfacing and paving; Wells Rd., 3-5 mi. gravel constr.; Apple way 1 mi. paving; Inland Empire Hwy., 1-mi. paving; Graham Rd., 4-5.mi. paving. Est. cost $25,000. Allen R. Scott, Co. Engr.

Wash., Toppenish—Resolutions passed by City Council to pave 70 blocks; same to be full width in business center; main arteries into town, 18 ft., and in some residence districts, 24 ft. Harvey Dunn, Engr. will prepare estimates.

Wash., Waterville—R. F. Foster, Co. Engr., preparing plans for following: grading and graveling 4 miles prem. hwy. No. 1-A, Est. cost, $18,000; also constructg. prem. hwy. No. 4-A. Est. cost, $10,000. Grading and surfacing Sunset Hwy. Est. cost $165,000.

Wyo., Cheyenne—Nine mi. conc. rd. to be built near Basin. Est. cost, $15,000 a mile. $200,000 rd. improvts. also to be made in district betw. Casper and W. Salt Crk. 17 projects surveyed for which Fed. aid will be asked; four addn. projects approved. Z. E. Sevison, State Hwy. Engr.

Wis., Chippewa Falls—Chippewa Co., considers bldg. 5,200 ft. 9-ft. crush. rock rd. on Bloomer-New Auburn Rd. Engr. G. H. Nickell. (P. C. Lokrantz,) Co. Hwy. Comr. Other rds. to be improved in above county are Cadott-Holoomle, 4,000 ft.; Chippewa Falls-Colfax, 5,200 ft.; Bloomer-Cornell, 8,000 ft., etc. etc.

Wis., Superior—City contemplates 18,006 yds. mono. brk. paving; also 8,792 yds. conc. Est. cost $69,000. W. B. Banks, City Engr.

SEWERAGE AND SEWAGE TREATMENT.

Cal., King City—Plans for sewage disposal plant prepared by City Engr., J. E. Olive, including septic tank and filter bed. Bids soon to be asked.

Cal., Los Angeles—City considering bond issue of $2,300,000 for construc. of Jefferson St. storm drain.

D. C., Washington—Washington Suburban San. Comm. planning 65 miles water and sewer constr. Total est. cost $2,100,000. In addn. $400,000 will be expended to take over all existg. water and sewer sys. in municipalities within san. dist.

Ga., Atlanta—City contemplating expenditure of $187,971 for sewer improvements, including completion of Highland Ave. trunk sewer system.

Ga., Mason—Bibb County Comrs. have decided to construct Camp Wheeler power system by convict labor. Est. cost. about $70,000.

Ill., Chicago—Following constr. work petitioned for by Engr. Dept.: Evanston Pumping Sta., $85,000; Desplaines Riv. Pump. Sta. and Treatment Pl., $140,000; Calumet Pump. Sta., $400,000; 95th St. Pump. Sta., $50,000; Desplaines Riv. Sewer, $100,000; Evanston Sewer, $525,000; Calumet Sewer, $1,495,000; Calumet-Sag Channel, $1,124,000; Main Channel Improvement, $500,000.

Ill., Chicago—City contemplates construct. of addn. to sewage-disposal plant on Chicago River near 39th St. Est. cost between $250,000 and $350,000. J. Erickson, City Engr.

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Ill., Decatur—City planning constructg. Imheff plant and 2 intercept. sewers. Est. cost $539,500. P. T. Hicks, City Engr.

Ill., Rockford—Plans being prepared for City for bldg. sewers. Est. cost $10,600. B. Hand, City Engr.

Ind., Evansville—Plans under way for sewer constr. in all newly acquired territory. extending Kentucky Ave. sewer and draning. Bee Slongh.

Ill., Waukegan—City considering 8-12 in. tile sewers in May and So. Jackson Sts. Est. cost, $3,521; 43-in. conc. storm drain in So. Victoria St., 9th St., and Lincoln Ave., at $10,215. M. J. Douhitt, City Engr.

Ill., Winnetka—Village having plans prepared by Mindes & Marsh, Engrs., 593 Birch St., for bldg. 1,596 ft. 15-46 in. tile sewers for storm sewer outlet. About $13,000. J. Marillan, Clk.

Ia., Des Moines—Plans being prepared for W. End sewer, 24 mi. in length. K. C. Kastberg, City Engr. Est. cost, $500,000.

Ia., Sioux City—City plans extensions to existing sewers at about $15,000; also bldg. storm sewers—possibly beginning storm sewer for Leeds—at about $25,000.

Kans., Belleville—Ord. passed to construct system of can. sewers, consisting of sys. of Disposal Works, outfall sewer, main intercepting sewer and sys. lateral sewers.

Kans., Horton—Preliminary plans being prepared by Black & Veatch, Engrs., 507 Inter-State Bldg., Kansas City, Mo., for instfalling sewage disposal plant.

Kans., Parsons—Plans being prepared by Black & Veatch, Sngrs., 507 Inter-State Bldg., Kans. City, Mo., for sewage disp. plant.

Kans., Salina—City having plans prepared for bldg. san. sewerage system, in North Side. Est. cost, about $20,000. P. G. Wakenhut, City Engr.

Kans. Wichita—City considering constr. of storm sewer to prov. drainage for residence distr., at foot of College Hill. Est. cost, $100,000.

Me., Portland—City contemplates bldg. 2300 lin. ft. 24-in. vitr. pipe on conc. fdn. About $20,000. E. M. Hunt, City Engr.

Md., Baltimore—City contemplates bldg. supplemental pumping sta. at Locust Point, and also new line to take care of sewage now emptying into Old Cabin Branch storm-water drain in East and N. E. Baltimore.

Md., Hagerstown—City planning bond issue of $750,000 for completing sewerage sys.

Mich., Dearborn—Plans prepared for constr. of san. sewer sys. and sewage disp. plant. Est. cost, $155,000. Clarence Hubbo, City Eng., Detroit.

Mich., Detroit—Additional approp. of $1,531,887 towards sewer construc. to be requested by Detroit Bd. of Estimates.

Mich., Detroit—Work on Third St. sewer (most important link in the $8,000,000 chain of sewer construction) will begin about May 1st.

Mich., Flint—Plans prepared for bldg. 4 mi. storm sewers and 6 mi. san. sewers. Est. cost, $55,000 and $56,000 respectively. E. C. Shoecraft, City Engr.

Mich., Pontiac—Bids will be asked about April 1st for constructing 5,000 ft. lateral sewers. Est. cost, $10,000. H. B. Barnett, City Engr.

Minn., Duluth—Plans being prepared for addn. to water system. Est. cost about $75,000. M. H. Wright, City Engr.

Minn., Janesville—City plans to install sewer sys. and sewage disp. plant. Approx. cost, $45,000. F. Bass, 344 Plymouth Bldg., Minneapolis, Engr.

Neb., Omaha—City contemplates extension of sewer system, if bonds to amt. of $400,000 are sold.

N. J., Hoboken—Plans have been submitted by Comr. M. I. Fagen, Director of Water Dept., to State Dept. of Health, for sewage disp. works for purpose of intercepting sewage of Wharton, Dover and Boonton, conveying same to point below Boonton Reservoir of Jersey City Waterworks.

N. J., Westmont—Plans being considered for san. sewers and joint system with Haddonfield.

N. Y., Brooklyn—Dept. of Pub. Work estimates sewer extension work at $40,000, and $300,000 for Sloan Drain.

N. Y., Brooklyn—Bd. of Estimate planning to construct sewers in following streets and avenues: Dumont, Williams, Louisiana, Pitkin, Stone and in Dumont. Est. cost about $695,000.

N. Y., Buffalo—City considering construction of sewers involving between 20,000 and 30,000 ft. conc. pipe, segmental block and earth trenching. About $200,000. G. H. Norton, City Engr.

N. Y., Canandaigua—State authorities have authorized City to construct sewage disposal plant, declaring it absolutely necessary.

N. Y., Long I. C.—City considering sewer construction of sewers in various streets throughout City. About $60,000.

N. Y., New York City—City contemplates a flushing tunnel to relieve condition of Newton Crk. Est. cost, $2,000,000. In connection with this project the question of providing adequate sewers is also being considered. Petition has been filed for construction of relief sewers.

N. Y., New York—Plans under way to build sewers in Elliot Manor Sec., Corona; also pumping sta. M. E. Connolly, Pres., Queens Boro. Est. cost, about $10,000. $27,000 appropriation also made for reconstructing sewer in E. 42nd St. Board of Est. has authorized sewer constr. in following streets: Broad, Van Cott Ave., High St., Hill, Herbert, Charles, Biebly (Queens Boro). Est. cost, about $50,000.

N. Y., New York—Appro. of $27,000 made by Bd. of Est. for bldg. sewer in E. 42nd St.

N. Y., Tuckahoe—$25,000 sewer bonds have been sold by City.

N. C., Charlotte—Major-Gen. J. T. Dickman, Commander of Camp Greene will construct sewer sys. costing several hundred thousand dollars.

N. C., Durham—City considering the enlarging of Third Fork Crk. disposal plant, including installation of sand filter. About $51,000 available. H. W. Kueffner, City Engr.

O., Akron—Plans for survey of entire sewerage sys. of City being considered by Serv. Director Morse.

O., Canton—Ords. passed to issue bonds totaling $399,000; $290,000 for east and west intercepting san. sewers.

O., Cleveland—City plans to complete filtration plant on West Side addn. work at sewage disposal plants at E. 140th St. and Lake; also at plant on canal and river between E. 40th and E. 71st St.

O., Cleveland—$2,000 appropriation made for sewering Hamilton Ave. Sewers to be constructed also in E. 134th, E. 132nd, E. 139th, E. 163rd and Lorenzo Aves. $500,000 bond issue authorized.

O., Columbus—City Chemist, Clarence Hoover, recommends that city sewage disp. plant be extended to lessen pollution of Scioto River water south of city.

O, Dayton—R. E. Kline, Engr., Callihan Bank Bldg., revising plans for disp. plant at Lebanon, O. Work includes settling tanks controlled by chambers, sand filters, slug beds, trunk sewer sys. and 15-in. vit. pipe.

O., Lima—$155,000 bonds to be sold by City for purpose of installing relief trunk sewers in Lima Sewer Distr.

O., Toledo—Bids will be asked by March 1st for constructg. 2 sewage pumping plants, involving 7 mi. 42-in. to 6-ft. Salem blk. conc. pipe sewers and 3 intercepting sewers involving 6 mi. 48 to 72-in. pipe. Approx. cost $800,000. H. McClure, City Engr.

O, New Boston—$10,000 bonds to be sold for purpose of extending and enlarging; also improving sewerage sys. Thos. D. O'Neal, Clk.

Okla., Miami—Bond issue of $100,000 voted for constr. of storm sewerage system.

Okla., Wynnewood—$16,000 bonds have been sold. Funds will be used for san. sewer system.

Pa., Meadville—City considering construction of sewage disposal plant. Approx. cost about $100,000. A. Reynolds, Mayor.

Pa., Philadelphia—Prospect Park Council planning to install sewer system to facilitate erec. of 100 houses.

R. I., Providence—Dr. Francis A. Carmelia, Pass. Asst. Surg., of Washington, in charge of investigation by U. S. Health Service experts who are now preparing report on pollution of waters of Narragansett Bay and vicinity, will recommend to Legislatures of Rhode Island and Mass., a joint system of sewage disposal.

S. C., Spartanburg—City contemplates sewer construction by day labor. Est. cost, $40,000. R. Tull, City Engr.

S. D., Lake Andes—City will build and equip proposed sewerage system; also disposal plant. Plans and specifications on file. Est. cost, $24,000. A. O. Steensland, City Aud.

S. D., Mitchell—Burns & McDonnell, Engrs., 402 Interstate Bldg., Kans. City, Mo., are preparing plans for improving waterworks system. About $125,000.

Tenn., Nashville—City Comm. has decided to issue bonds to amount of $300,000 for sewer construction.

Tex., Dallas—City will install storm sewer in Colonial Ave. Approx. cost, $20,000.

Va., Richmond—City soon to receive bids for bldg. sewer in Lee Dist. west of Lombardy St. About $50,000. C. E. Bolling, City Engr.

W. Va., Lock Seven—Alex. Potter, Consulting Engr., 50 Church St., N. Y., has been engaged by War Dept., Washington, D. C., to prepare plans for design and constr. of sewerage sys. for Govt. explosive plant.

Wis., Milwaukee—Approximately $360,000 provided in 1918 budget for sewer construc.; also $1,460,000 for sewage disp. plant.

WATER SUPPLY AND PURIFICATION.

Ala., Montgomery—Comr. C. J. Tyson urges installation of six more 12-in. wells and an 8,000,000-gal. electric pump.

Cal., Delano—$45,000 bonds sold. Funds will be used for erec. of 100-ft. tank, drilling well ,and installation of pumping plant, cap'y 1,000 gals. per min.

Cal., Fullerton—Water Bd. has instructed Director Sherwood to prepare plans for reservoir to hold 300 ins. of water for 12 hrs.

Cal., Porterville—Plans almost completed for new pumping plant to be installed on "E" St, as auxiliary to City Water Sys. Est. cost of installation, exclusive of pump and bldg., $1,900.

Colo., Loveland—Plans being prepared for City for bldg. stand-pipe and rein.-conc. tank, 260,000-gal. cap'y.

Colo., Sterling—City Council has voted for bond issue of $25,000 for purpose of carrying out experimental work for better water supply on other side of river.

Fla., Key West.—City contemplating construction of water system. Est. cost, $1,000,000.

Fla., Tarpon Springs—City will install engine with hourly cap'y of 15,000 gals. at waterworks. Est. cost, $13,500.

Ga., Dublin—$15,000 bonds voted for construction of sewer and water mains. Ests. being prepared for waterworks sys., to involve about 10,000 ft. Class "B" pipe. M. J. Guyton, Engr.

Idaho, Twin Falls—$375,000 bonds voted for new municipal waterworks sys.

Ill., Belvidere—$10,000 will be expended by City in improving water system.

Ill., Quincy—Water Comrs. may advertise soon for bids for erection of standpipe and pumping station. Est. cost standpipe, $30,000; remainder of $80,000 to be used to install pumps, erect pumping sta., and make necessary connections.

Ind., E. Chicago—Bids soon to be asked for construct. of filteration plant for E. Chicago and Ind. Harbor Water Co. Est. cost, $89,000. Metcalf & Eddy, Engrs., 111 W. Monroe St., Chicago, Ill.

Ind., La Porte—City contemplating building waterworks system. City Engr., Burtis P. Thomas is co-operating with John Harding, Supt. of Waterworks in preparing complete sys. of maps and plans for proposed work.

Ia., Clarinda—Plans being prepared for City by Burns & McDonnell, Engrs., Interstate Bldg., Kans. City, Mo., for bldg. new water supply and extending present waterworks plant. About $75,000.

Ia., Des Moines—Plans under way for new waterworks plant, changing source of water supply from Raccoon River watersheds to Des Moines River. K. Kastberg, City Engr.

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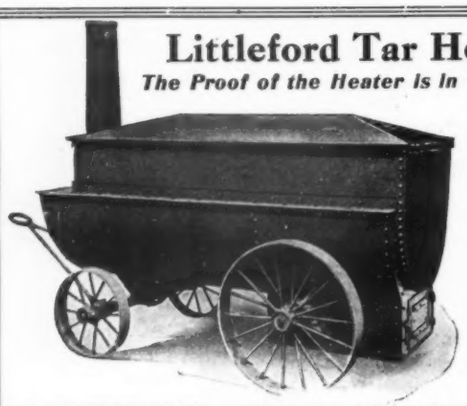
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The majority of all municipal issues do not reach the investor directly, but pass through the hands of a dealer who specializes in their purchase and sale.

There are several hundred municipal bond dealers located throughout the country. Many of these bond firms buy a great variety of issues from counties, cities and villages located in the East and West, North and South.

Since a really successful sale will only result from competitive bidding participated in by many different bidders, it is clear that a municipality should advertise its bond offering in a paper specializing in bond news and read by all the dealers interested in this news.

The Bond Buyer, issued daily and weekly, is just such a medium! It never speaks of anything but municipal bonds, and, after twenty-five years of this specilization, it has come to be accepted by legislators and public officials as **"The Authority on Municipal Bonds."**

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BACK NUMBERS OF MUNICIPAL ENGINEERING.

We need a few copies of MUNICIPAL ENGINEERING for January, 1906, vol. 30, No. 1; November, 1910, vol. 39, No. 5; December, 1915, vol. 49, No. 6. We will extend the subscription for two months of any one sending a copy of either of these or six months for all three. Send word by card or letter of mailing the magazines, so that you will be sure to get the credit.

ENGINEERING PUBLISHING CO.,
702 Wulsin Bldg.,
Indianapolis, Ind.

Bids received until March 18, 1918.
COMBINED SANITARY AND STORM SEWERS.
Cape Girardeau, Missouri.

Sealed bids will be received until seven o'clock P. M., March 18th, 1918, by the City Council, for construction of a combined sanitary and storm water sewerage system, in accordance with the plans and specifications therefor on file in office of City Clerk. Copies of said plans and specifications may be obtained from R. W. Frissell, City Clerk, upon payment to him of the sum of fifty dollars ($50.00), which will be refunded to bidders, provided said plans and specifications are returned to City Clerk on or before March 21, 1918. Full information and bidding sheets may be obtained of the aforesaid City Clerk. Estimated cost of work, $250,000.00.

CHRIS. E. STIVER,
City Engineer.

Bids received until March 5, 1918.
QUAY CONSTRUCTION
Board of Wharf and Dock Commissioners
Office, City Hall
Beaumont, Texas.

Sealed bids will be received by the city council of the city of Beaumont for furnishing all tools, material, labor, etc., for constructing the following work at Kirby's Point, City of Beaumont, Texas, namely:

One thousand feet of quays, including dredging, excavation, filling and removal of old piles and all other incumbrances.

Seven hundred and fifty feet of quays, including dredging, excavation and removal of old piles and all other incumbrances.

Five hundred feet of quays, including dredging, excavation, filling and removal of old piles and all other incumbrances.

A certified or cashier's check in the sum of five per cent. of the amount of said bid or bids, made payable to Emmett A. Fletcher, mayor, on some Beaumont bank or trust company will be required to accompany each bid. (Check for 5 per cent. on 1,000 feet of quays, etc., will answer for all three lengths.)

For specifications, plans or other information apply to the office of the Board of Wharf and Dock Commissioners, City Hall, Beaumont, Texas. Said plans and specifications will be furnished for five dollars, which will be returned to the unsuccessful bidders, upon return of all plans and specifications in good order.

If contractors desire they may submit designs of their own to conform with the city's plans and specifications.

Bids to be considered must be filed on or before 10 o'clock A. M., March 5th, 1918.

Said bids should be addressed to J. G. Sutton, City Secretary, City Hall, Beaumont, Texas, and marked "Bid for Quay Construction."

The city council reserves the right to reject any and all bids.

J. G. SUTTON,
City Secretary.
C. L. SCHERER, Engineer.

Bids received until March 5, 1918.
PUMPING EQUIPMENT.
Flint, Mich.

Sealed proposals for constructing, installing and testing one fifteen (15) million gallon, one hundred and fifty (150) feet total head geared turbine driven centrifugal pumping unit with condenser and auxiliaries addressed to the Board of Water Commissioners of the City of Flint, Michigan, and endorsed (Proposal for Pumping Unit) will be received at the office of the Board until 8 P. M. on Tuesday, March 5th, 1918, and will be publicly opened and read at that time.

Each proposal shall be accompanied by a certified check in the sum of one thousand dollars ($1,000.00).

The Board reserves the right to reject any and all bids and to accept such bid as will be to the best interests of the City and agrees to accept one of the bids or reject all bids on or before April 1st, 1918.

DR. B. F. MILLER,
F. H. RANKIN,
WM. VEIT.
Board of Water Commissioners.
F. N. BALDWIN, Superintendent.

Bids received until March 6, 1918.
ROAD CONSTRUCTION.
Long Branch, N. J.

Notice is hereby given that sealed bids will be received by the Board of Chosen Freeholders of the County of Monmouth for the reconstruction of Norwood Avenue, in the City of Long Branch, in the County of Monmouth, with a sheet asphalt surface upon a macadam foundation; estimated amount of surface pavement required is 20,408 square yards; of new foundation, 10,204 square yards; and opened and read in public at the Freeholders' Office, Court House, Freehold, N. J., on Wednesday, March 6th, 1918, at eleven a. m.

Drawings, specifications and forms of bid, contract and bond for proposed work, prepared by George D. Cooper, County Engineer, and approved by the State Highway Commission, have been filed in the office of the said engineer, 60 Broad Street, Red Bank, N. J., and of said Commissioner, State House, Trenton, N. J., and may be inspected by prospective bidders during business hours. Bids must be made on standard proposal forms in the manner designated therein and required by the specifications, must be enclosed in sealed envelopes, bearing the name and address of the bidder on the outside, with the name of the work bid on, addressed to C. E. Close, clerk of said Board, and must be accompanied by a certified check or cash for not less than $1,000, and be delivered at the place and on the hour above named. The standard proposal form is attached to the specifications, copies of which will be furnished on application to engineer.

By order of the Board of Chosen Freeholders of the County of Monmouth, N. J.

C. M. WYCKOFF, Director.
Attest:
C. E. CLOSE, Clerk.

Bids received until March 7, 1918.
DEPARTMENT OF PUBLIC WORKS,
OFFICE OF THE BOARD,
Room No. 2, City Hall.
Fort Wayne, Ind., Jan. 28, 1918.

Notice is hereby given by the Board of Public Works of the City of Fort Wayne, Indiana, that sealed proposals will be received by them at their office on Thursday, March 7, 1918, at 3 o'clock P. M., for the construction of the following public improvements:

For the construction of a pumping station building for the Water Works Department in Swinney park.

All work done in the building of the aforesaid improvement shall be in accordance with the plans and specifications now on file, and may be seen in the office of the Department of Public Works of said city.

The bidders in submitting proposals for the aforementioned work must accompany bids with a certified check in the sum of one hundred ($100.00) dollars, payable to the city of Fort Wayne, Indiana, as evidence of good faith that he will execute within five days from date of acceptance of proposal a contract and bond satisfactory to said Board of Public Works.

A failure of the successful bidder to enter into such a contract and bond upon the acceptance of such proposal, will forfeit the check and sum of money payable thereon to the City of Fort Wayne, Indiana, as agreed and liquidated damages for such failure.

J. O. BROWN,
A. T. ANDERSON,
C. L. BAIRD,
Board of Public Works.
Attest:
ROBERT D. EVANS, Clerk.

Bids received until March 12, 1918.
NOTICE TO CONTRACTORS.
National Forest, Cass County, Minn.

Sealed proposals for constructing or improving the National Forest Road Project located within or partly within the Minnesota National Forest, State of Minnesota, County of Cass, will be received by the District Engineer, Office of Public Roads and Rural Engineering, at his office in the Post Office Building, Minneapolis, Minnesota, until one (1) o'clock on the 12th day of March, 1918, at which time they will be publicly opened and read by the said District Engineer.

The right is reserved to reject any and all bids, and none will be considered except those from contractors ascertained to be experienced and responsible.

The length of project to be constructed or improved is approximately 0.3 miles, and the principal items of work are approximately as follows:

To build 535 feet of timber pile trestle and 1,025 feet more or less of embankment approaches.

The work embraced in this contract shall be completed within seventy-five (75) weather working days.

Maps, plans, specifications, and estimate of quantities, may be examined by responsible contractors at the following addresses:

District Engineer, Public Roads and Rural Engineering, Room 224 Post Office Building, Minneapolis, Minnesota.

Supervisor, Minnesota National Forest, Cass Lake, Minnesota.

All proposals must be made on forms, and in accordance with instructions, forming a part of the specifications above referred to.

E. O. HATHAWAY,
District Engineer.

Bids received until March 5, 1918.

REINFORCED CONCRETE BRIDGE.

County Commissioners' Office of Labette County, Kansas.

Oswego, Kans.

Board of County Commissioners of Labette County, Kansas, will receive bids March 5, 1918, for construction of one reinforced concrete bridge. Approximate steel, 20,000 pounds; yardage, 335 cubic yards. Plans and specifications can be obtained from W. J. King, County Engineer, Oswego, Kans., for $1 per set. Estimated cost approximately $6,100.

Bids received until March 5, 1918.

CLEANING RECEIVING WELL.

Bordentown, N. J.

City Clerk's Office, Bordentown, N. J.—Sealed proposals for cleaning receiving well at Water Works will be received here until 7:00 P. M., March 5th, 1918, and then opened. Information on application.

Bids received until March 5, 1918.

GRADING AND PAVING.

New Castle, Pa.

Lawrence County, Pennsylvania, will grade about six (6) miles of highway and pave same with concrete sixteen (16) ft. wide. Bids will be received until 11 a. m., eastern time, March 5, 1918. Plans, specifications and conditions of bidding can be seen at the office of Thomas A. Gilkey, C. E., 318-322 Mercantile Building, New Castle, Pennsylvania, and same must be examined before bidding.

Bids received until Apr. 23, 1918.

HIGHWAY CONSTRUCTION.

Santo Domingo, West Indies.

The Department of Public Works of the Dominican Republic will receive bids until 10 A. M. the 23rd of April, 1918, for the construction of five sections of highway having a total length of about 103 kilometers; about forty-five kilometers to be macadamized and the remainder to be constructed as a dirt road.

Separate proposals will be received for each section and for the entire work. The Department reserves the right to reject any or all propositions.

The Dominican Republic is governed by United States Naval Officers placed in charge by the United States Government.

Plans and specifications can be secured from the office of A. J. Collett, Director General of Public Works, Santo Domingo City, Dominican Republic, West Indies.

You Can Sell Our Line

of trucks, tractors and trailers to contractors and make big money on a commission basis. Our 2-ton truck is priced at $1,990; our 4-ton trailer is priced at $735, and our line of 5 and 6-ton semi-trailers is also exceedingly low in price. Information on our 4, 5 and 6-ton tractor will interest you. We make the entire line of trucks, tractors and trailers and guarantee immediate delivery. We will give good territory to the right men—also a liberal commission. Get in on the freight haulage game. Many contractors heretofore specializing in building construction are going to take contracts for freight haulage, and they will require our kind of equipment. Address "Trailer Combination," care Municipal Engineering, 538 S. Clark St., Chicago, Illinois.

MISCELLANEOUS WANTS

WANTED—Salesmen now selling concrete mixers, hoists, engines, etc., to contractors, to sell our line of double-end and semi-trailers on a commission basis in conjunction with their other lines. We manufacture a complete line of two and four-wheel trailers and can promise immediate deliveries. Our prices are lower than the prices of any other reliable make and our terms are liberal. Address "Trailer," care Municipal Engineering, 538 S. Clark St., Chicago, Ill.

WANTED—Contracting salesmen to sell our line of 2-ton, 2½-ton, 3½-ton and 5-ton trucks to contractors. Immediate deliveries. Liberal discounts, generous terms, strongest truck with the greatest capacity in the world. Address "Immediate Delivery," care Municipal Engineering, 538 S. Clark St., Chicago, Ill.

WANTED—Successful salesmen to sell our line of 2-ton trucks ($2,190) to contractors on a commission basis in conjunction with their other lines. Our truck is regularly carrying 3½ to 4-ton loads. Immediate deliveries promised. Address "Salesmen," care Municipal Engineering, 538 S. Clark St., Chicago, Ill.

WANTED—Experienced salesmen to sell our line of concrete mixing machinery on a commission basis to contractors. Something entirely new in mixing and placing concrete. Our method mixes and conveys concrete through a 4 or 6-in. pipe line without any clogging. This method is patented and is in satisfactory operation with the largest contractors in the country. Liberal commission to the right men. Address "Pneumatic," care of Municipal Engineering, 538 S. Clark St., Chicago, Ill.

WANTED—Salesmen to sell our line of steam and gasoline street and road rollers (with special scarifier attachment) on a commission basis to contractors. Best line of road rollers on the market and lowest in price. Immediate deliveries guaranteed. Address "Roller," care of Municipal Engineering, 538 S. Clark St., Chicago, Ill.

WANTED—Salesmen to sell our 1-ton trucks ($350), Ford attachment, to contractors on a commission basis; 56-in. rear tread without large rear wheel sprockets and consequent injury from both chains and sprockets. The strongest, yet lightest, truck, and has been known to carry 2½-ton loads continuously for months without a cent of repairs due to breakdowns. Address "Ford Attachment," care of Municipal Engineering, 538 S. Clark St., Chicago, Ill.

WANTED—Salesmen to sell our complete line of contractors' locomotives which operate on any kind of liquid fuel. Lowest priced locomotive in the world—yet the most durable, and satisfactory in operation. Fires quick. A one-man machine. Sticks to the track. Immediate deliveries. Liberal commissions and discounts. Large territories to the right men. Address "Locomotive," care of Municipal Engineering, 538 S. Clark St., Chicago, Ill.

WANTED—Successful and reliable salesmen to sell our line of 2-ton trucks ($1,990), 6-ton trailers ($760), 2-ton tractor trucks on a commission basis. We make trucks and trailers in our own factory and guarantee immediate deliveries. Address "Tractor Truck," care of Municipal Engineering, 538 S. Clark St., Chicago, Ill.

WANTED—Salesmen to sell our line of 5-ton dump trucks to contractors on a commission basis. Low in first price. Extra heavy frame. Oversize engine; 20 per cent super-strength all the way through. Develops 11 per cent greater power than the highest priced 5-ton truck on the market. Immediate deliveries.

POSITIONS WANTED

POSITION WANTED—Advertising solicitor with several years' successful experience with leading publications in lumber and machinery fields desires a new connection as sales or advertising manager, or both, with leading manufacturer of paving materials or contractors' machinery. Can furnish best of references; initial salary, $3,000. Address "Sales Engineer," care of Municipal Engineering, 538 S. Clark St., Chicago, Ill.

POSITION WANTED—Sales manager for leading western manufacturer of contractors' machinery and equipment desires to fill similar position for leading motor truck manufacturer or new motor truck concern with reliable backing. Understand the making and selling of contractors' machinery and am personally acquainted with leading salesmen selling contractors' machinery and motor trucks on big work. Have very successful record as a sales manager as well as a salesman, but desire to make new connection on account of present firm's ability to make deliveries. In position to reorganize motor truck dealers' methods whereby they will sell more trucks to contractors. Have sold fleets of trucks to contractors and understand the contractors' methods of buying. Address "Sales Manager," care of Municipal Engineering, 538 S. Clark St., Chicago, Ill.

POSITION WANTED—Manager of excavator sales who has been selling output through leading contracting salesmen, working entirely on a commission basis, desires to make connection with manufacturer of trucks in a position to make immediate deliveries. Will open reliable and satisfactory commission selling agency in unoccupied territory and will successfully work out plans in such a way that this manufacturer will eventually secure the best motor truck dealer in the different localities. Can furnish best of references; thirty-six years of age, married. Address "Excavator," care of Municipal Engineering, 538 S. Clark St., Chicago, Ill.

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our line of Motor Trucks, ranging in capacity from 1¼ to 5 tons, to contractors who want immediate delivery. Only salesmen experienced in selling the contracting trade need apply. Our 5-ton truck is really a 6-ton truck, and is oversized all the way through; internal gear drive, with many new features of special interest to contractors. If you have made a big record in the selling of steam shovels, excavators, concrete mixers or other similar lines, and are willing to split our factory discount of 27 per cent. with the best truck dealer in your locality in order that service be assured on the trucks which you sell, we would like to hear from you, with particulars as to lines already handled, territory covered, etc. Address "Internal Gear," care Municipal Engineering, 538 S. Clark St., Chicago, Ill.

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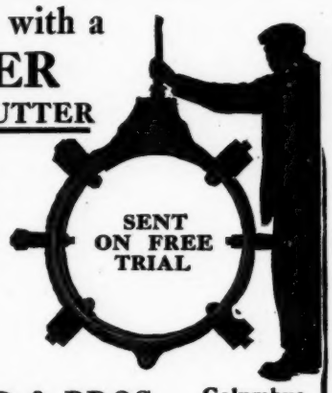

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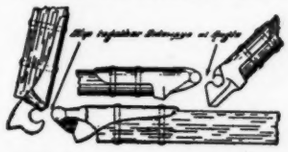

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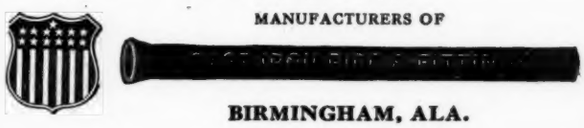

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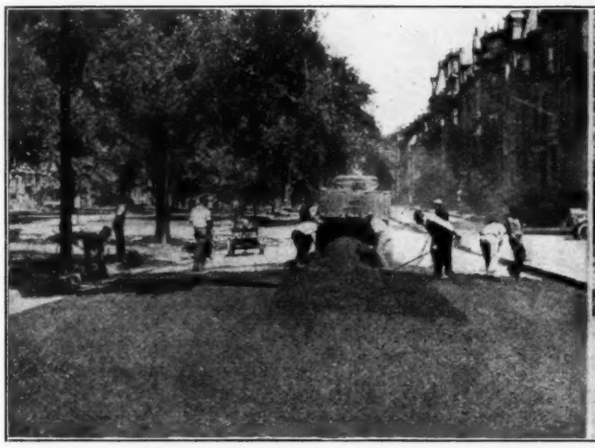

Laying Bitulithic Pavement on old Macadam foundation, Commonwealth Avenue, Boston, Mass., south side at corner of Clarendon Street, 1916.

Bitulithic Pavement laid over old Macadam foundation, Commonwealth Avenue, Boston, Mass., at intersection of Berkely Street, showing parkway on left, Public Gardens in background.

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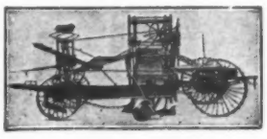
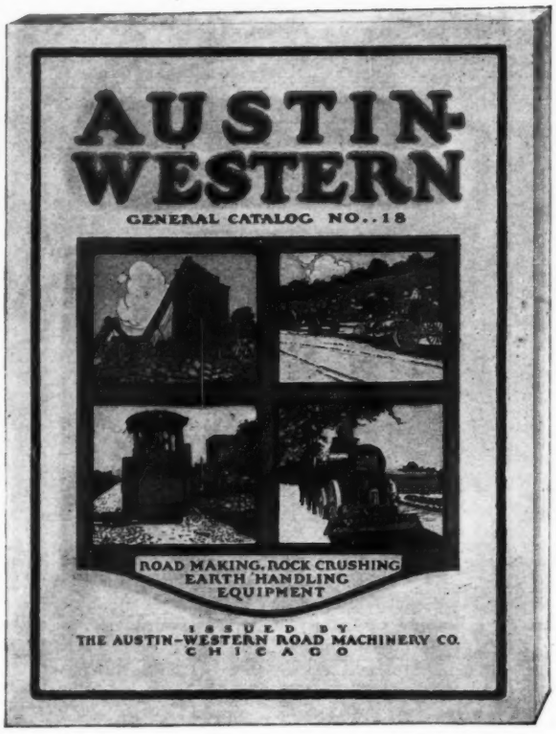


Austin Elevating Grader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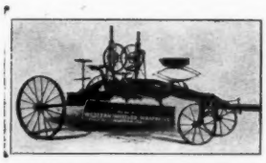

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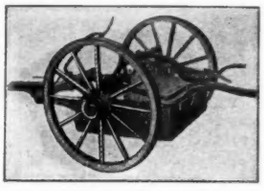

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